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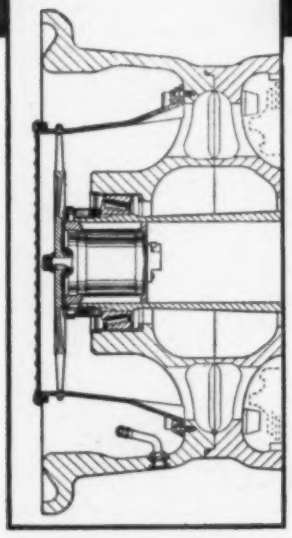

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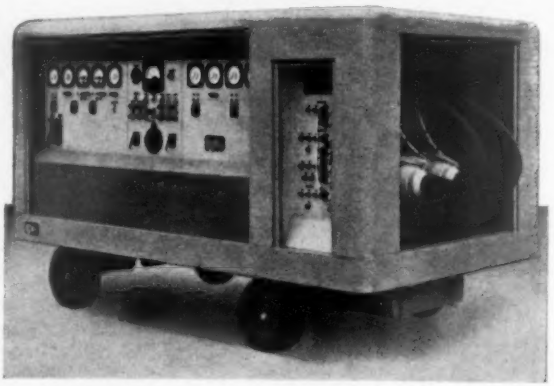

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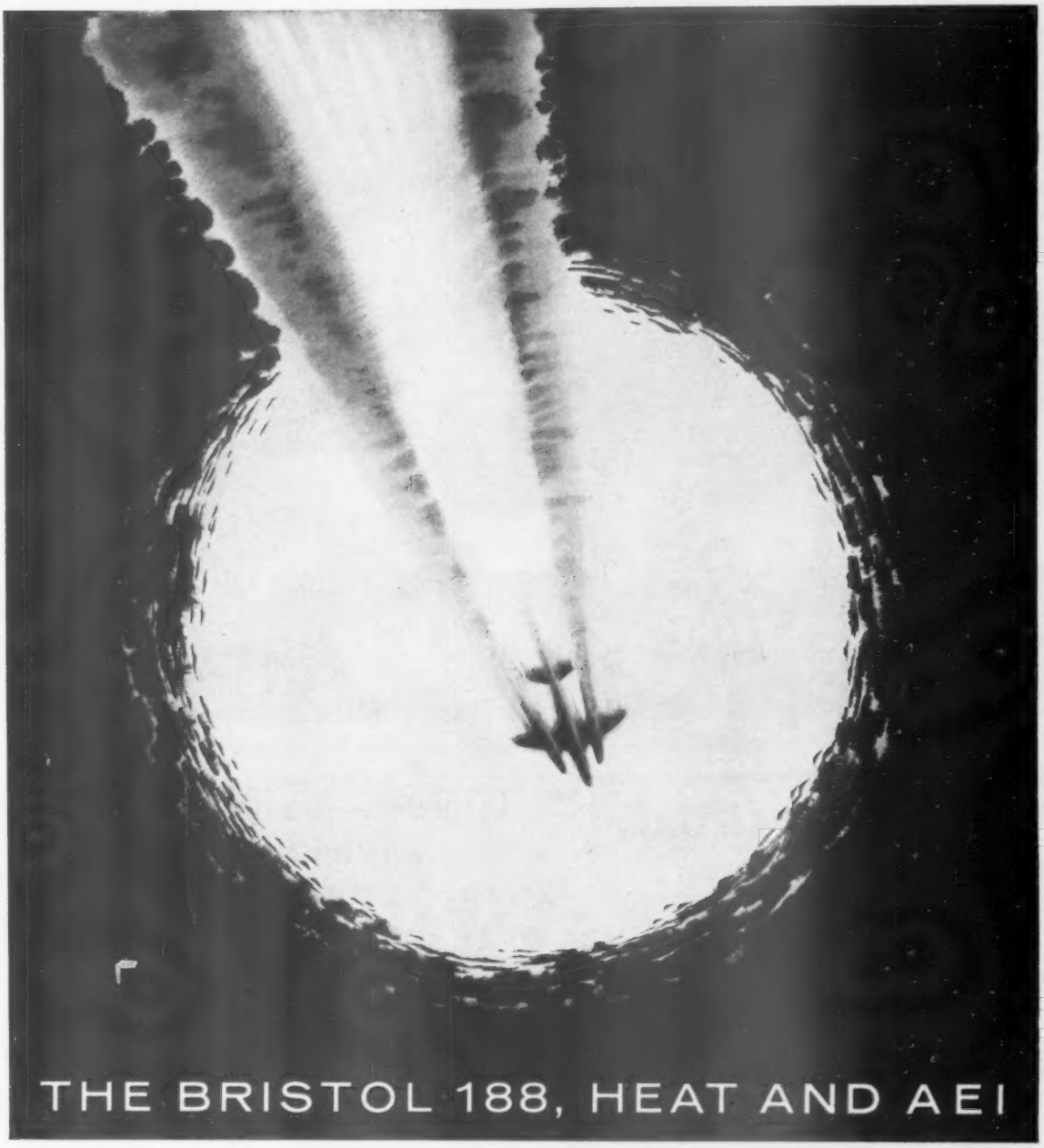

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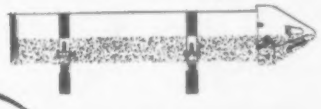

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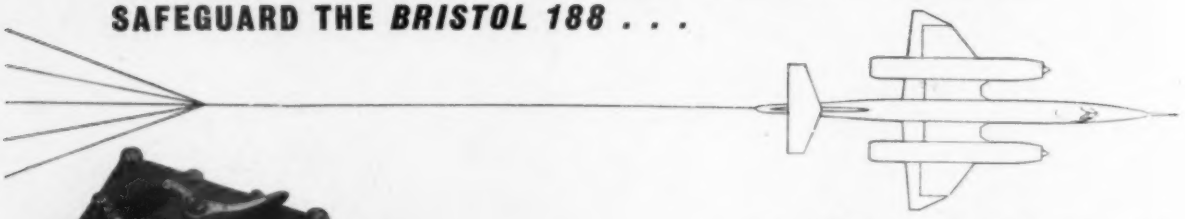

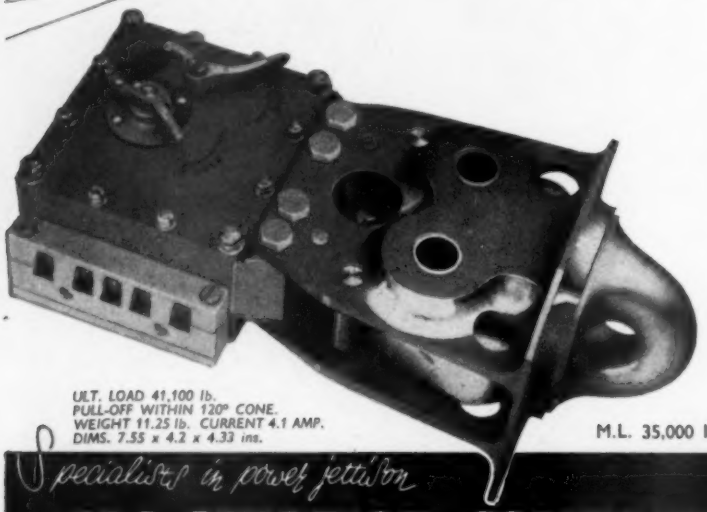

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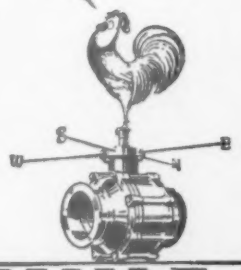

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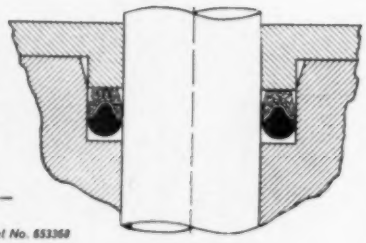

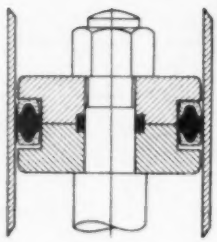

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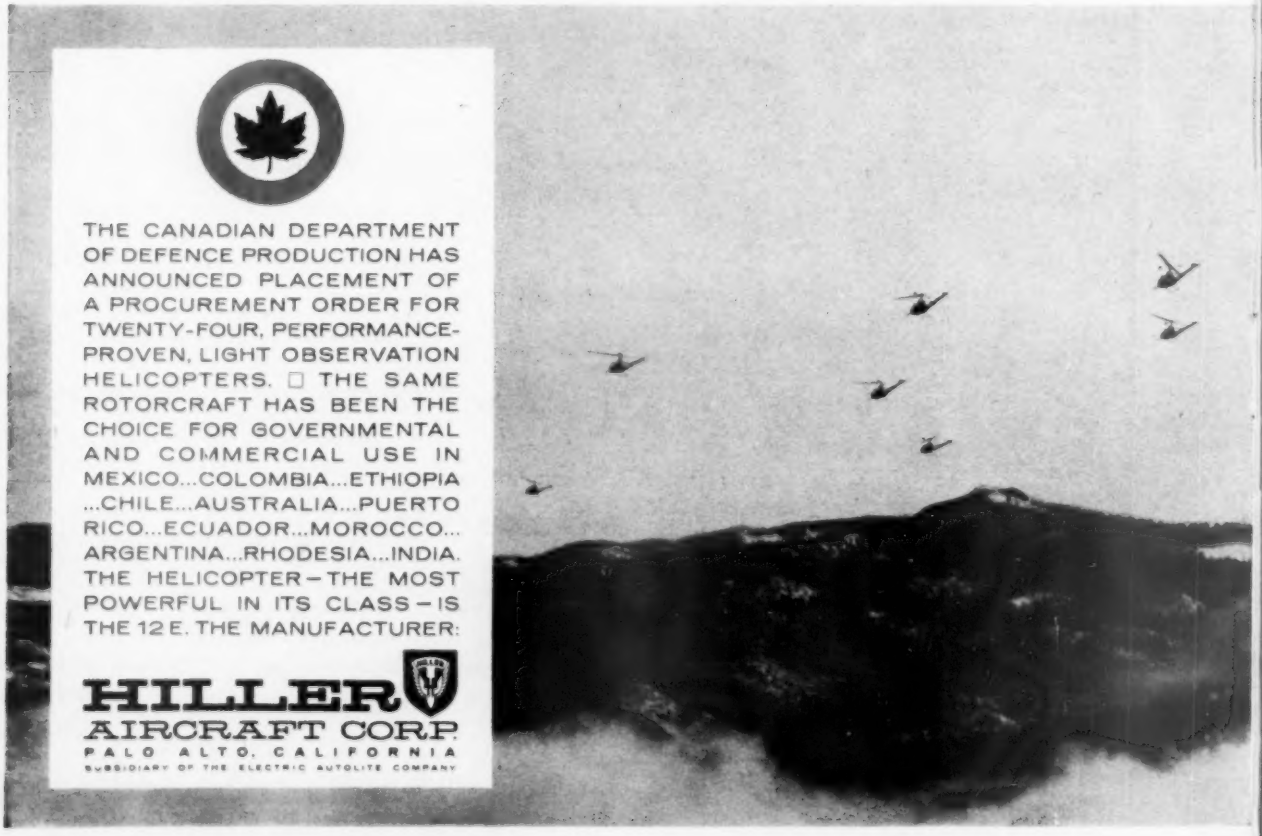

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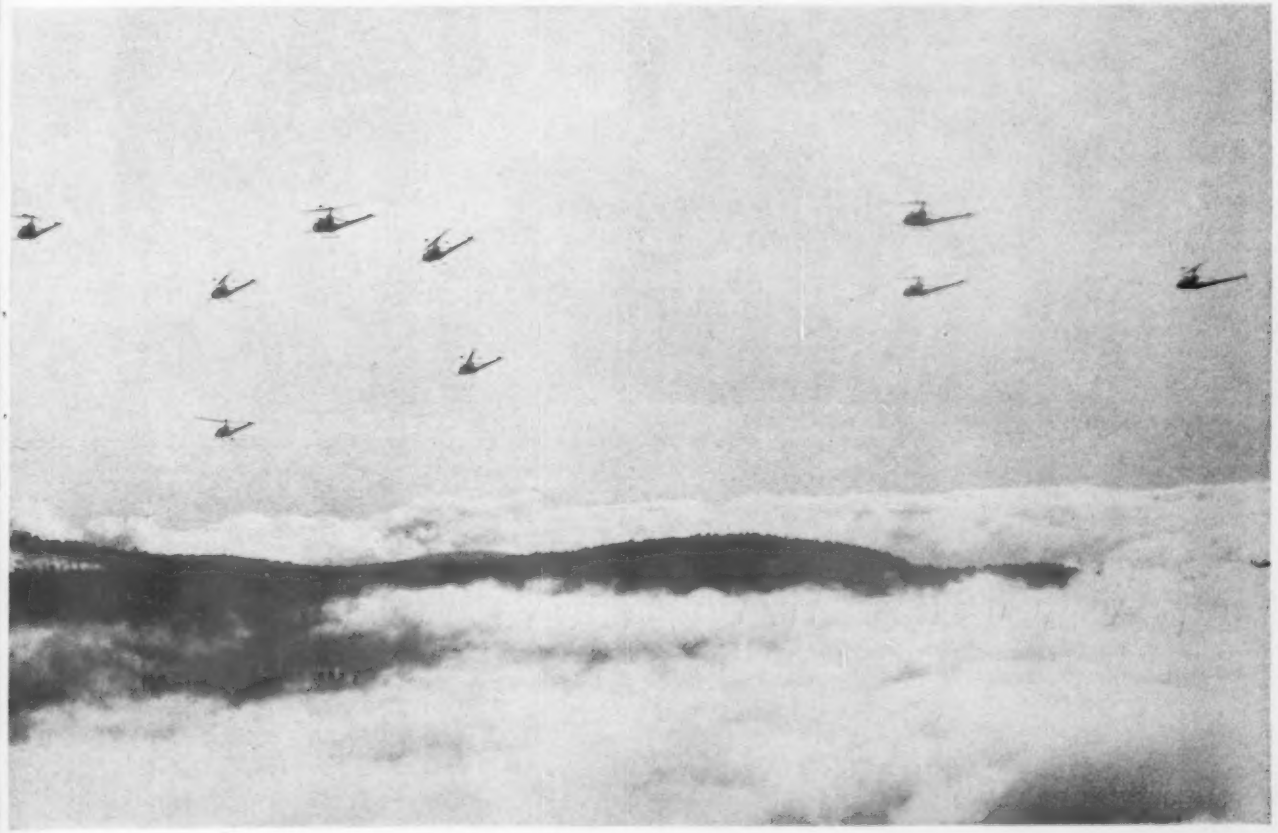

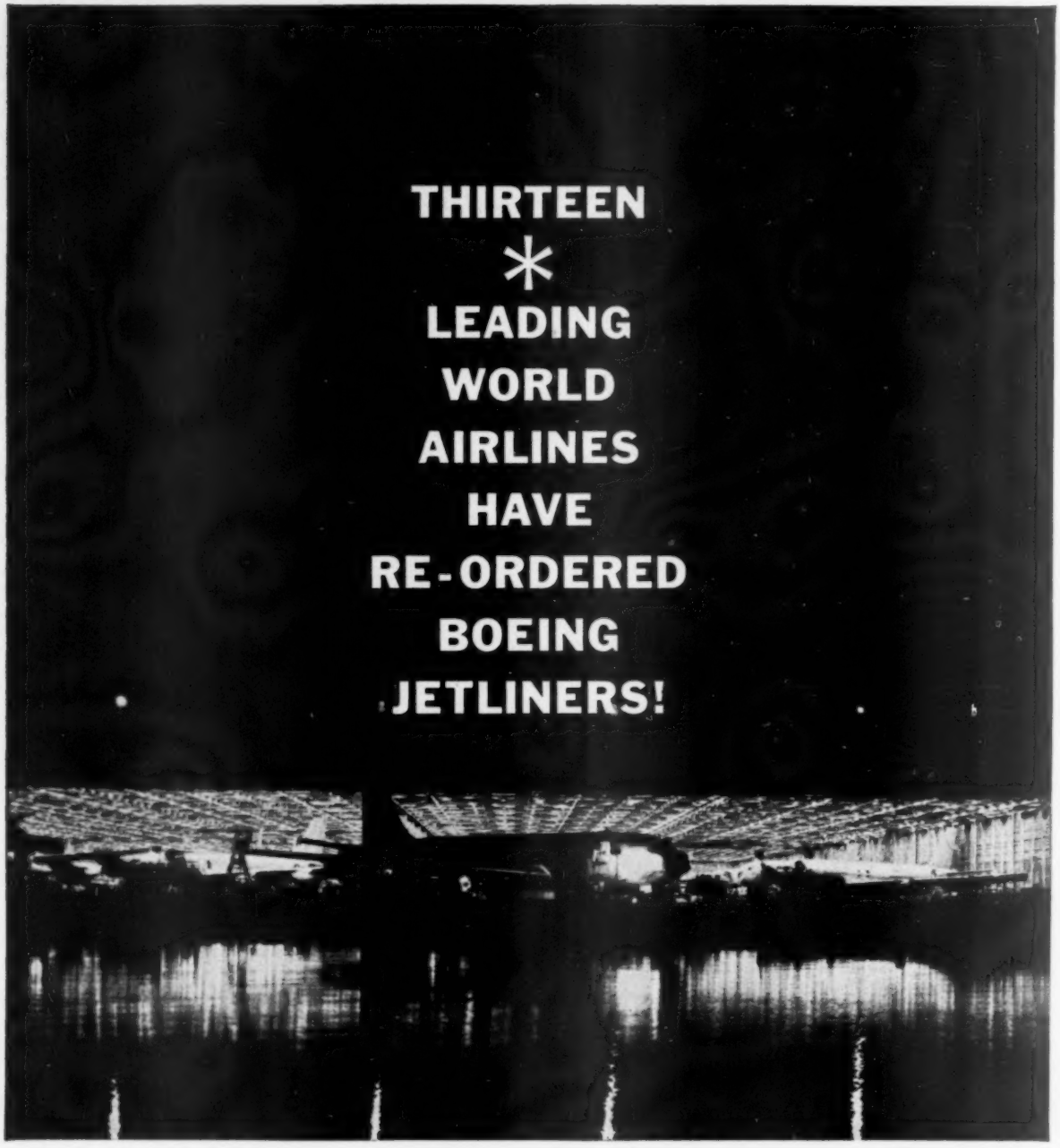

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THE AEROPLANE and ASTRONAUTICS

VOLUME 100 NUMBER 2586 MAY 11, 1961

Manhours and Space

Everyone seems to have taken for granted the technical miracle that made it possible for a man rushing through the sky 115 miles above the Earth's surface at over 5,000 m.p.h. to be heard by millions of his fellow men as he calmly, methodically, worked through the closely scheduled list of duties that were to occupy every second of his 15-minute ride through the inner edge of space. Yet the ability conferred by this marvel of communications enabling millions of listeners, all over the World, to hear for themselves what the first American astronaut was doing, had two supremely important results. The first was to establish in the minds of these millions the complexity of the technical organization and the scale of the engineering and scientific teamwork needed to put a man into a ballistic trajectory and to bring him safely back. Perhaps even more importantly, participation in the operation enabled every radio listener or television viewer to associate himself extremely closely with the American point of view and with the feelings of the U.S. as a nation. The experience must have done a great deal to consolidate the Western World.

We can all be sure that the successful space shot last Friday is going to spur the United States on to fresh efforts. The question that remains to be answered is what are the other nations of the Western World going to do. It is perhaps not unreasonable to seek the answer in some form of co-operative undertaking. The news published last week of the recent results of the work of the Jodrell Bank team on establishing the distance of Venus from the Earth provides an effective illustration how one country can help another by making proper use of unique equipment. It is clear that every British effort to increase the accuracy obtained in making such calculations must be of immense value to the American teams planning the launching of probes towards Venus.

No figures have been compiled, so far as we are aware, to establish exactly the volume of effort needed to put Cdr. Shepard into space, keep him there for a few minutes and then bring him back safely to Earth. We have no doubts that the manhours involved in the flight itself, in the preparations for it, in the development and building of the Mercury capsule, the escape gear, and the adaptation of the Redstone rocket, were astronomical.

It seems clear that the deeper some inhabitants of the World manage to probe into space, the more fantastic will become the manhours involved in each shot. It cannot be long before the requirements become so enormous that only by international teamwork will progress be possible.

The Still Small Think

By way of contrast to the efforts needed to get a man into space, writers in this country and in the United States have recently been informed of what can be done with very small teams of scientists and engineers. We refer to a paper read in the United States by E. S. Calvert, the English scientist, famous for his lighting system.

He is anxious that there should be a more general recognition in the modern world of the value of operational research. This latter he defines as working out means whereby new techniques and inventions can be profitably used in practice. As an example he quotes the barren results following the introduction of radar to the merchant marine. What is particularly disturbing is Mr. Calvert's allegation that under existing conditions the legal responsibility which rests on the air pilot to avoid collision in VFR conditions requires both pilot and air traffic controller to do things which are operationally impossible.

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Matters of Moment

Taking Over at Eastleigh

ON Sunday, May 14, the Ministry of Aviation is withdrawing from Southampton (Eastleigh) Airport, which is re-opening at 08.00 hrs. the following morning under the aegis of a private company, Southampton Airport, Ltd. Principal of the new concern, which has purchased the freehold of Southampton Airport, is J. Nat Somers, well known for his post-War air racing activities, and for operation of the London Aero Club and Panshanger airfield.

Southampton will continue to be licensed for public use, and facilities for scheduled services will be available on the same basis as in the past. Plans are also in hand to develop Eastleigh as a centre for executive aircraft and business flying, and some modification of the current control zone around the airfield is expected.

The reopening of the airport under private enterprise is to be marked by a small ceremony, attended by some of the civic dignitaries from Southampton, and the possible arrival of such airline and executive types as the Handley Page Herald and the Grumman Gulfstream.

No change is expected in the status of the resident organizations at Eastleigh, including the Hampshire Aeroplane Club, except that private flying will become simpler following the removal of the P.P.O. restriction on the use of the airport. The airfield control frequency will remain 124.5 Mc/s, and an application has been made for 118.3 in addition.

Mr. E. Dyer has been appointed commandant.

A New President for the R.Ae.S.

FOLLOWING custom, the annual general meeting of the Royal Aeronautical Society on May 4 marked the end of the term of office of one president and the induction of another. Air Marshal Sir R. Owen Jones, K.B.E., C.B., A.F.C., B.A. (Cantab.), D.I.C., F.R.Ae.S., M.I.Mech.E., took office as the Society's 28th president in succession to Dr. E. S. Moult, C.B.E., B.Sc. (Eng.), F.R.Ae.S., M.I.Mech.E.

Sir Owen brings to his new office a wealth of experience in aviation and a distinguished Service background. He joined the Royal Air Force in 1924 following his education at Epworth College, Rhyl; Manchester College of Technology; Cambridge University and Imperial College. In his post-graduate studies he specialized in research into high-compression aero-engines.

In the R.A.F. his spells of flying duty alternated with his technical duties, and he served in Egypt and India as well as in England both as a pilot and as a technical officer until 1938. During this period he commanded station workshops engaged on aircraft maintenance and overhaul work and gave technical instruction to officers and airmen. From 1931-1934 he was at the R.A.E. Farnborough engaged on instrument design, in particular on the development and air-testing of the gyro-magnetic distant reading compass. During the pre-War period, too, he spent more than two years in command of No. 11 (Bomber) Squadron in India and took part in the opening of the air reinforcement routes from the North West Frontier eastward to Singapore and westward to Cairo.

Air Marshal Sir R. Owen Jones, president of the Royal Aeronautical Society for 1961-62.

Photograph copyright "The Aeroplane and Astronautics"

Immediately before the Second World War he was recalled from India to become the Air Ministry Overseer at Sir W. G. Armstrong Whitworth Aircraft, Ltd., and Armstrong Siddeley in Coventry. In this task his principal concern was to see the Whitley bomber into Service use.

He was a member of the British Air Commission in the U.S.A. from 1941 to 1943, after which he returned to England as Deputy Controller of Research and Development at the Ministry of Aircraft Production. This post he held until 1946.

Immediately after the war in Europe ended, Sir Owen took part in the evaluation in Germany of the aeronautical research and development which had taken place there during the War. From 1946-1947 he served with Technical Services (Plans) at the Air Ministry and was then appointed Air Officer Commanding No. 24 Group, Technical Training Command. In 1948 he spent a year as Senior Air Staff Officer, R.A.F. Reserve Command, and then returned as A.O.C. to No. 24 Group, which controlled much of the technical training of apprentices and airmen of the R.A.F.

In 1952 Sir Owen was appointed Controller of Engineering and Equipment at the Air Ministry—a post he held until he retired from the Royal Air Force in 1956. Since then he has been a consultant and is also an independent member of certain Government committees. He was president of the Institution of Mechanical Engineers in 1958.

Sir Owen is no newcomer to R.Ae.S. affairs. He joined the Society in 1947 and was elected a Fellow in 1950. He has served on the Council since 1955 and was a vice-president of the Society from 1957-1960.

Export Boost

DURING the first three months of 1961, exports by the British aircraft industry were worth £41¼ million—a figure exceeded only once before, during the second quarter of 1959. Aero-engine sales were a record at £22¼ million, more than half the total.

If this quarterly export rate were maintained for the rest of 1961, the total would be more than £166 million. This would beat the record of £156 million set up in 1956.

In March exports were worth £16½ million, the third highest monthly total on record. These exports included aero-engines worth more than £8 million; the aircraft included Vanguards which were delivered to Canada and Comets sold to the Lebanon.

In the 44 months since July, 1957, the industry's exports have earned £558 million. This is about half of the post-war total of £1,126 million. Engine exports have accounted for about one-third of the total exports since the War, but now they make up more than half the export sales. It is clear that aero-engine manufacturers are now doing better than the airframe companies in export markets.

What More Operational Research Could Do

A PLEA for a more general recognition of the value in the modern world of operational research was put forward by E. S. Calvert, recipient of the 1960 Monsanto Aviation Safety Award in New York recently. He was addressing the annual meeting of the U.S. Aviation and Space Writers' Association.

As scientific inventions multiply, more and more thought should be given, so Mr. Calvert argues, by specially trained groups to the development of economical procedures for using them in combination. To avoid administrative friction, it is important that this be done early.

We have institutes for civil, mechanical and electrical engineering, and for the aeronautical sciences, etc., but Mr. Calvert would like to see in each country an Institute for Operational Research. Also, in his view, students of the sciences should be given a few lectures at the end of their professional training on the methods used in operational research.

At present, what research is done seems to be largely in the hands of engineering psychologists or "human engineers," but these tend, if left to themselves, to produce lengthy and indigestible "reviews," without much in the way of concrete technical solutions. Engineers and scientists must try, says Mr. Calvert, to realize the possibilities of this kind of research, and be willing to co-operate with the engineering psychologists.

As an example of what he has in mind, he quoted the case of the Visual Glide Slope Indicator which was recently adopted by both the U.K. and the U.S. Mr. Calvert's group has been

AVRO TWINS.—Seen together for the first time in this picture are the two prototype Avro 748s, each powered by two Rolls-Royce Darts. News of the Skyways contract for three Avro 748s is on page 512.

given the credit for this, but it is doubtful whether they would have pursued the idea *as a matter of urgency* if it had not been for some excellent operational research done by General Caldara's group as early as 1953. The latter investigated 14 million landings and showed that a high proportion of the accidents at landing was due to visual misjudgments in good weather. Mr. Calvert had already suspected as much by reading the accident reports, but, as a basis for administrative action, there is all the difference in the world between a mere hunch and an exact statistic supported by unassailable evidence. The group did not suspect, however, that the accident rate for this kind of procedural failure was (at that time) so very much greater for jet aircraft than for propeller-driven aircraft. As soon as Mr. Calvert saw the statistics he realized that something had to be done quickly if the civil jets were to operate safely all over the World, and, as it turned out, the technical solution was simple.

Such an example shows what could be done if there were small and efficient operational research groups in each country continuously exchanging information. This work does not require a large number of people (Mr. Calvert's own staff consists of two) but they must combine scientific knowledge and operational experience with a peculiar kind of insight not very common in this busy uncontemplative modern World. The kind of insight required does not come from extensive reading of scientific papers, or elaborate experimentation, but rather from quiet brooding on the problem, undistracted by executive responsibilities, but with close day-to-day contact with those who actually do the job.

There are some differences between the approach lighting systems used in the United States and Europe, and Mr. Calvert does not see how these can be resolved other than by careful operational analysis. In the absence of this, international discussions often produce little result.

The second example, collision avoidance, is more general because it concerns safety at sea as well as in the air; in fact the experience of the seamen in this matter provides a useful object-lesson for airmen. It is about 15 years since radar began to be installed in ships, and the proportion of deep-sea ships so equipped is probably now about 80%. Since the traffic density at sea has remained nearly constant during the past 10 years or so, one would expect a substantial reduction during this period in the proportion of the World fleet involved in collision each year. Actually this proportion 10 years ago was one in 13, and, believe it or not, that is just about what it is today. In other words, this magnificent tool is not fulfilling its capabilities in an important part of its operational job, and there are, in fact, no generally accepted and easily applied rules for using it.

Mr. Calvert has reached the conclusion that the solution to a large part of the marine problem is very simple. All that is needed is to adopt a convention as to the rotation of the sight-line, i.e., the line joining the two ships. He has tried to explain this to many seamen, but finds, in general, that they regard the whole idea with suspicion, in spite of the elegant and interesting results which flow from it. Airmen are, of course, likely to be more receptive.

In Mr. Calvert's view the legal responsibility which now rests on the air pilot to avoid collision in VFR conditions needs to be re-examined, because if his work is correct the pilot, and to some extent the air traffic controller, is each being required to do something which in some cases is operationally impossible under present conditions.

R.A.F. Books of Remembrance

SEVEN officers and airmen and one airwoman, representing the R.A.F., Princess Mary's R.A.F. Nursing Service and the W.R.A.F., carried eight Books of Remembrance into the sanctuary at the R.A.F. Church of St. Clement Danes last Sunday where they were dedicated by the Bishop of Maidstone, the Rt. Rev. Stanley W. Betts. Containing the names of more than 105,000 men and women who were killed in the R.A.F. and its associated Services during the 1939-45 War, the books were placed in separate shrines in the church. Copies for closer inspection will always be on view.

The Dedication Service, which marked the start of a Week of Commemoration during which the R.A.F. is keeping watch over the books, was attended by H.R.H. the Duchess of Kent, the Duke of Kent and several hundred relatives of those commemorated. Air Chief Marshal Sir Thomas Pike, Chief of the Air Staff, read the lesson.

Two other volumes not yet completed, covering the period up to Sept. 2, 1939, and the period since the War, will be dedicated at a later date.

H. B. Irving Commemorated

A NEW annual award, to be called the H. B. Irving Award, was announced at the annual general meeting of the R.Ae.S. Man-Powered Aircraft Group on May 5. Mr. R. Graham, F.R.Ae.S., who was elected chairman for the coming year, said that the award had been offered by Mrs. Nora S. Irving in memory of her husband, the group's first chairman, who died recently following a motoring accident. The committee has decided that it will take the form of a cash prize and a medal, given annually for the best paper on man-powered flight to appear in one of the society's publications, starting in 1962.

Mr. B. S. Shenstone was re-elected vice-chairman, and Mr. C. H. Latimer-Needham was added to the committee, which also includes Messrs. J. M. Gray, G. Lilley, A. Newell, D. G. A. Rendel, Peter Scott, and Dr. D. R. Wilkie, the physiologist.

Mr. Kremer, who last year offered a prize for the first successful man-powered flight, has been told by several people that the conditions laid down are too arduous. However, they may like to be reminded that the committee will have power to review the conditions next year if the prize is not won within two years of its being offered.—A.E.S.

Matters of Moment . . . .

Evaluators of Aerospace

THE forward-looking A.T.S. Company, which collates, evaluates and distributes technical information to Hawker Siddeley Aviation companies, is to be reorganized on more comprehensive lines. As part of these moves, Air Cdre. F. R. Banks, managing director of Blackburn Engines, Ltd., and Mr. P. G. Lucas, special assistant to Sir Aubrey Burke, the chairman of the de Havilland Aircraft Co., Ltd., have been elected to the board of the A.T.S. Co., Ltd.

His new appointment will not affect the responsibilities of Air Cdre. Banks in relation to Blackburn Engines, and he will continue as managing director of that company. Mr. Lucas will be responsible for Services liaison.

The rôle of the A.T.S. Company will be to provide Hawker Siddeley Aviation with a central information, evaluation, analysis and market assessment service in the aerospace field, affecting aircraft of all types, powerplants, ballistics devices, and orbital and space vehicles.

It will also incorporate, under Mr. A. H. Stratford, a transport and economics department built around a special team originally formed and controlled by Sir W. G. Armstrong Whitworth Aircraft, Ltd., a member company of H.S.A.

Mr. M. N. Golovine, who joined the A.T.S. board in 1955, will continue as managing director. Since his appointment to this position two years ago, he has already expanded the services and scope of the organization and was largely responsible for the creation of the Franco-British HSA/SEREB Initiative Group for the study of aerospace industrial potential in Western Europe.

The A.T.S. board will now comprise: Air Cdre. F. R. Banks (chairman), Mr. M. N. Golovine (managing director), Mr. J. T. Lidbury (chief executive, H.S.A.), Mr. S. D. Davies (technical director, H.S.A.), Mr. J. A. R. Kay (sales director, H.S.A.), Mr. J. C. Floyd (chief engineer, H.S.A., Advanced Projects Group), and Mr. P. G. Lucas.

At present the company's headquarters will remain at 18 St. James's Square, London, S.W.1.

B.A.C. in America

WITH an eye to furthering development and expansion of its business on the other side of the Atlantic, the British Aircraft Corporation has formed a new company—with its headquarters in Arlington, Virginia—for the express purpose of promoting the sale of aircraft and guided weapons in the United States. This new company is to be known as the British Aircraft Corporation (U.S.A.) Inc., and will have as its president Mr. Christopher Clarkson, A.F.C., A.F.R.Ae.S., A.F.I.A.S., who for very many years has had close associations with British aviation interests in the U.S.A. He has more recently been particularly concerned with the affairs of Vickers-Armstrongs (Aircraft) as their North American representative. During the War he served with the British Air Commission on the East Coast test and development flight and subsequently became chief of the Commission's test branch in Washington. He was the British civil air attaché in Washington from 1948 to 1952.

Executive vice-president of the new company is Mr. P. Murry-White who has been vice-president of Vickers-Armstrongs Incorporated since 1959. He was previously with Vickers-Armstrongs (Aircraft) at South Marston and Weybridge.

Vice-presidents of the British Aircraft Corporation (U.S.A.) Inc. are Mr. E. L. Beverley, now sales manager (guided weapons) of B.A.C.; and Mr. A. H. C. Greenwood who is chairman of the B.A.C. aircraft sales committee and sales director of Vickers-Armstrongs (Aircraft). The fifth member of the new board is Mr. E. S. Dean who is the English Electric company's representative in the U.S.A.

Air Vice-Marshal W. C. Sheen, C.B.E., D.S.O., has been appointed as the American company's director of military sales. The director of technical sales is Mr. F. C. Hydes.

Short's Long-haul Cargo/Passenger Transport

A NEW swing-nose two-deck version of the Short SC.5 Belfast civil freighter was described last week by Mr. H. G. Conway, deputy managing director of Short Bros. and Harland, Ltd., at an air-cargo system presentation sponsored by B.O.A.C. and B.E.A. This new Belfast is designed for long-haul cargo and passenger transport and is intended to carry payloads of up to 100,000 lb. non-stop between New York and London. It could offer a one-way crossing of the Atlantic for as little as £30 per passenger.

Following intensive study over the past year and discussions with the major civil freight operators, Shorts have concluded that most of the cargo systems so far proposed are unsatisfactory and that a new approach is necessary. Their investigations showed that containers or palletized loads must not be too high if they are to be manageable at loading centres, and that freighters must be able to carry passengers as well as freight. The best height for a load, whether on a pallet or loaded in a container, is about 6 ft.; anything higher complicates loading and risks the crushing of the lower layers.

These considerations have led to the latest version of the SC.5 Belfast, which has two floors. The lower floor is of light construction and carries three rollerways on to which pallets can be loaded. On the sides of the fuselage about 6 ft. above the floor are two longitudinal lines of rollers for loading a second layer of pallets or cage-like containers.

This will allow the aircraft to carry about 55,000 lb. of freight on pallets on the lower floor, plus 138 passengers, together with full amenities, on the upper floor. Alternatively, 100,000 lb. of freight could be carried—60,000 lb. on the lower and 40,000 lb. on the upper floor.

Although a built-in rear loading door is the best solution for a military freighter, an aircraft designed for specialized container traffic will be more effective with a swinging nose, according to Mr. Conway. This allows the full volume of the aircraft to be loaded in one operation. The new version of the Belfast has a swinging nose; the existing ramp and door in the rear fuselage have been eliminated, saving a substantial amount in structural weight. Mr. Conway said that these simple structural changes would have no effect on the overall aerodynamics, weights and handling of the aircraft and would present few development problems.

In the passenger version there will be luggage space at the sides of the seats. It is intended that passengers will carry their own luggage aboard and stow it in the side cavities. Large suitcases would be shipped as freight. These simplified arrangements already allow one American airline to offer substantially reduced fares to passengers prepared to turn up at the gate and take their chance on seats being available. The Belfast layout will be so flexible that combinations of freight and passengers can be arranged at will and at short notice; conversion of the upper floor from all-cargo to all-passenger will be possible in under an hour.

Shorts feel that a new and imaginative approach must be made to the problem of handling cargo on the ground. At present, substantial delays are caused during transhipment from the aircraft to the warehouses; these delays could undoubtedly be minimized by the introduction of suitable automatic terminals.

Mr. Conway described Shorts' conception of a typical North Atlantic cargo terminal of 1970. Loads would arrive by road, either in containers pre-packed at the factory, or made up in the cargo terminal. A full load of pallets would be made up ready for the aircraft in the terminal in the same way as goods wagons in a railway marshalling yard. On arrival an aircraft would taxi up to the ramp, open its door and unload its cargo. This would be shunted to one side on a trolley and a second trolley moved into place in front of the aircraft, which could then be filled up once more. The whole operation could be carried out in about 30 minutes—the time taken to refuel the aircraft and change crews.

B.U.A. Buys the One-Eleven

WORK is to begin at once on production of the British Aircraft Corporation One-Eleven (BAC-111) short-haul jetliner, to allow airline deliveries to begin in 1964. The One-Eleven is the first aircraft project of the British Aircraft Corporation and it is being undertaken as a joint venture with Government participation. The first announced order for the One-Eleven is from British United Airways, which is purchasing ten, with an option on five more, for deliveries to begin in the autumn of 1964. This order is valued at over £8 million.

BAC also has a letter of intent for five from Ozark Air Lines and Continental Airlines is "extremely interested" and expected to reach a firm decision within 90 days.

The One-Eleven is described as a jet successor to the Viscount, able to carry up to 69 passengers at "better than Viscount economics." It has an unusually wide cabin, 124 inches at elbow level, providing for five-abreast seating, with access through a forward door and ventral airsteps.

Two Rolls-Royce R.B.163-1 Spey by-pass turbojets, with a guaranteed minimum take-off thrust of 9,850 lb. at sea level, are rear-mounted on the fuselage. With 20 deg. sweepback at quarter-chord, the wing is free of projections and maximum use is made of the trailing edge for Fowler-type flaps. The design has been evolved from the original Hunting 107 of several years ago, which was based on two rear-mounted Orpheus engines. Sir George Edwards, executive director (aircraft), BAC, has described its evolution as follows:—

"After the merger, a joint Vickers-Hunting-Bristol study was made of this aircraft [the Hunting 107] and its market. It became clear that there were, in fact, two markets. One was for an airliner somewhat larger, heavier and having a higher power-weight ratio than the original 107, and the other was for an aeroplane very akin to the 107. After a very careful evaluation, we have decided to go ahead immediately with the larger version which is known now as the BAC One-Eleven, and to follow this up—about a year later—with the lighter BAC-107. These two aircraft are complementary and stand in something like the relationship of the Viscount 700 series to the Viscount 800 series. In this case, however, we are building the larger aeroplane first—reversing the order that was followed with the Viscount."

The BAC-107, with 7,350 lb. Bristol Siddeley BS.75 turbofans, will be shorter and lighter than the One-Eleven, with less sophisticated equipment.

As the One-Eleven is intended for short-haul operations and quick turn-rounds, it will carry an auxiliary power unit as standard equipment, to provide ground conditioning and self-starting. The structural design and aircraft systems will be based on BAC group experience with, for example, Vanguard and VC10-type wing panels machined from the solid.

Detail design of the One-Eleven is already under way, and the prototype is to fly in the spring of 1963. All companies in the BAC group will participate in production, with the final assembly line at the Vickers plant at Hurn. An initial batch of 20 is being laid down.

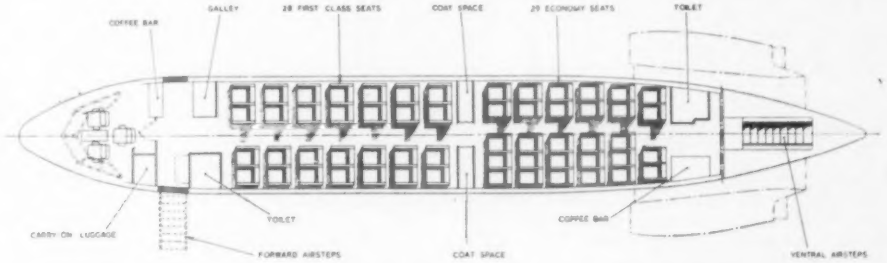
Technical Data

Dimensions: Span, 88 ft. 6 in.; length, 93 ft. 8 in.; overall height, 23 ft. 9 in.; gross wing area, 980 sq. ft.; aspect ratio, 8; sweepback, wing 20 deg., tailplane 25 deg.; u/c track, 14 ft. 3 in.; wheelbase, 31 ft. 9 in.; total cabin length, excluding flight deck, 53 ft. 9 in.; total accommodation length between toilets, 44 ft. 6 in.; interior height, 6 ft. 6 in.; interior width, 10 ft. 4.3 in.; freight hold volumes, 300 cu. ft. front, 200 cu. ft. aft.

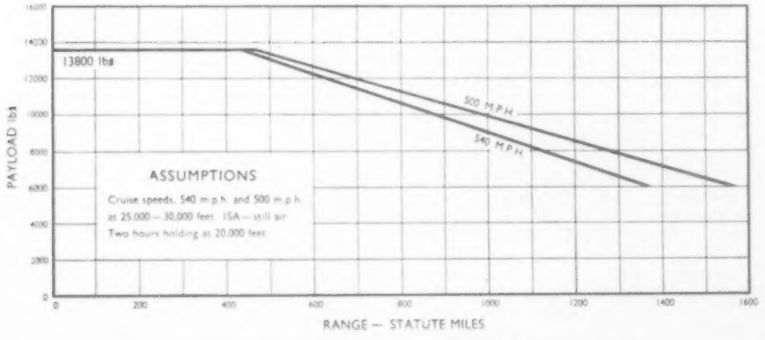
Weights: Fuel, 18,000 lb. (2,250 Imp. gal.); design payload, 14,000 lb.; max. ramp weight, 66,300 lb.; max. take-off weight, 66,000 lb.; max. landing weight, 62,500 lb.; max. zero-fuel weight, 56,000 lb.

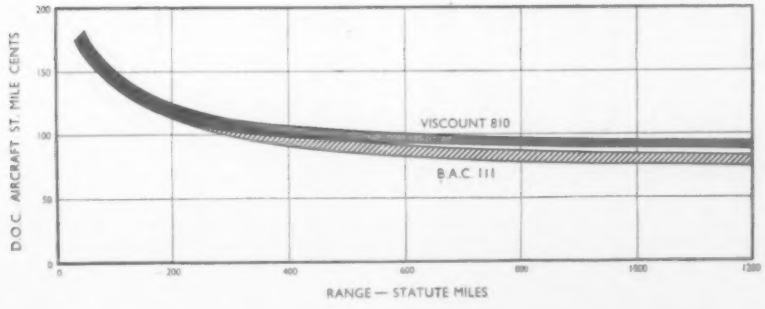
Performance: Best cost cruising speed, 434 knots; high speed cruise, 469 knots; take-off field length required, I.S.A., s.l., at 66,000 lb. weight, 4,800 ft.; ranges (with two-hour fuel reserves), with 57 passengers, 695 naut. miles; with 57 passengers and 2,400 lb. freight, 390 naut. miles; with 43 passengers, 1,040 naut. miles; with 69 passengers, 390 naut. miles.

Economics: Direct cost estimates based on seven separate costing methods including ATA (1955), ATA (1960), SBAC and four airlines. With 57 seats, 2.6 cents/seat-mile at 100 miles, 1.4 cents/seat-mile at 750 miles. With 69 seats, 17% lower. Break even passenger needs based on ATA costs, direct=indirect, revenue 7 cents/seat-mile: 31 passengers at 200 miles, 26 at 400 miles, 22 at 600 miles and 21 at 800 miles.



General arrangement of the One-Eleven, and a typical 57-seat mixed-class layout, are shown here. The operating cost curves based on seven separate calculations using A.T.A., S.B.A.C. and airline estimating procedures, with a similar band of costs calculated for the Viscount.





Aviation News in General

OPPORTUNITY WAITS.—An opening exists on the editorial staff of THE AEROPLANE AND ASTRONAUTICS for a young man keen on aeronautical journalism, with a suitable technical background up to R.Ae.S. standards. Particulars, marked confidential, should be sent in the first place to F. T. Meacock, THE AEROPLANE AND ASTRONAUTICS, Temple Press Limited, Bowling Green Lane, London, E.C.1.

SUPER CARAVELLE.—M. Hereil, president and general manager of Sud-Aviation, announced last week-end that plans for the medium-range supersonic Super Caravelle would be shown to M. Buron, the French Minister of Transport, on May 8. He said it would enter service in 1967-68.

DOPPLER CONTRACT. — The U.S.A.F. has placed a $1½ million order with Canadian Marconi, Montreal, for a quantity of airborne Doppler navigation equipment. Deliveries are due to start in August and the equipment is to be installed in MTS C-130E Hercules.

BOEING RESTYLED.—The Boeing Company is now the style of this American manufacturer. The word "Airplane" has been dropped in recognition of the company's diversified areas of effort and is intended to avoid any implication from its name that its interests are restricted to aircraft.

BALLOON ASCENT.—Carrying two U.S. Navy officers in an open gondola, a balloon released on May 4 from the U.S.S. "Antietam" in the Gulf of Mexico reached a height of 113,500 ft. The previous balloon record of 102,800 ft. was established last August by Capt. J. Kittinger, U.S.A.F. Unfortunately, in this latest attempt one of the two occupants of the gondola lost his life during the subsequent recovery operation.

HISTORY ON THE MOVE.—Moving of the national aeronautical collection into a new gallery at the Science Museum, South Kensington, began on May 1. The new gallery forms the top floor of a three-storey block now being built as an extension to the museum. It is 225 ft. long, 80 ft. wide and 30 ft. high to the centre of the arched roof. It will be opened in 1962.

SWISS MIRAGES.—The Swiss Parliament last week was asked for credits of 871 million francs (about £72,600,000) for the purchase of 100 Dassault Mirage IIIC Mach 2 fighter-bombers for the Schweizerische Flugwaffe. The Mirage will be built in Switzerland under licence, but many parts and electronic equipment will be imported from France. According to BUP, the Swiss Mirages will be powered by the Atar 9C turbojet.

SIDEWINDER ACCIDENT.—A short circuit in the electrical system caused by moisture led to the release of the Sidewinder AAM from an F-100 which on Apr. 7 shot down a B-52 during training attacks. The U.S.A.F. said that the pilot of the F-100 was fully cleared of any blame in connection with the accident.

JET COMMANDER.—A rear-engined, mid-wing 4/6-passenger executive jet aircraft is being built by Aero Commander Inc. Known as the Model 1121 Jet Commander, it is offered for delivery in the second half of 1963 at $560,000 fully equipped, with two 2,850 lb.s.t. General Electric CJ610-1 turbofans. Gross weight is 14,000 lb., cruising speed Mach 0.8 above 20,000 ft.

JUPITER FIRING.—An Italian Air Force team has successfully launched a Jupiter IRBM from Cape Canaveral, their first training firing of this missile.

COMBINED OPERATION.—Mock-up of the U.K./U.S. satellite S-51 which will embody research instruments—mainly for ionospheric study—designed and built in Gt. Britain. It should be launched by a four-stage Scout rocket early next year.

MUSCLEPOWER CORRECTION.—In Mr. H. R. Barnard's letter on Manpowered Aircraft published in our Apr. 27 issue a line was inadvertently omitted. His letter made the point that the Crouch-*Bolas Dragonfly was of the same configuration as the Bossi*-Bonomi and was powered by a relatively small engine but lifted at 15 m.p.h. The words in italics failed to appear in the printed version.

STOL ASTAZOU.—The Astazou-powered Dornier Do 27T test-bed has completed more than 70 hr. flying since its recent first flight, and there is a possibility that the remaining 20 or so aircraft from the Luftwaffe order may be of this type.

HERCULES JUNIOR.—A smaller version of the Lockheed C-130B, with only two Allison T56 turboprops, is reported to be under development. Max. payload would be 33,000 lb., with a gross weight of 66,000-79,000 lb.; carrying 20,000 lb. payload it would cover 1,450 naut. miles at 248 knots; the ferry range would be 3,240 naut. miles. Semi-STOL performance is claimed—2,000 ft. to clear a 50-ft. obstacle.

RUSSIAN ROTORCRAFT.—A single-seat sporting helicopter is being developed in Russia by Yaroslav Gashulyak. Known as the G-1, it has an Irbit motorcycle engine, weighs 440 lb. and has a top speed of 56 m.p.h.

TEAL's DC-6s.—The R.N.Z.A.F. is to buy TEAL's three DC-6s as an interim step in the Government's plan to re-equip the Transport Wing. They will remain in military service for two or three years. No. 40 Sqn. at present has three H.P. Hastings.

THOR TRAINING.—The training of R.A.F. Thor missile personnel has been handed over to Bomber Command by the U.S.A.F. In future all crews will be trained at a new strategic missile school set up at R.A.F. Feltwell.

SUBTERRANEAN TITAN. — First firing of a Titan ICBM from a 146-ft.-deep silo was made at Vandenburg on May 3.

HIGH-ENERGY.—It was disclosed at the B.I.S. Symposium on "Liquid Hydrogen as a Rocket Propellent" that R.P.E., Westcott, have given detailed consideration to the design of a liquid oxygen/liquid hydrogen engine with a static thrust of 2,020 lb. By replacing H.T.P./Kerosene in the third stage of the proposed launching vehicle based on Blue Streak and Black Knight, LO_2/LH_2 combination would increase payload for a close-orbit satellite by 50% (i.e., 1,800 lb. to 2,700 lb.).

SPACE TELESCOPE.—Explorer XI, the 95-lb. tumbling satellite fitted with a gamma-ray telescope (see our issue of Apr. 13, p. 391), was launched by a Juno II rocket from Cape Canaveral on Apr. 27. Its perigee is about 300 miles and apogee about 750 miles.

MOON MISSION. — Russia's long-range space programme is said to include sending two spaceships to the Moon by 1967. They would be preceded by unmanned "soft-landers" depositing supplies and propellents.

SKY "EYE."—An 80 ft. dia. steerable radio-telescope is to be built near Crowthorne, Berks, by the Ministry of Works for the Radio Research Station of D.S.I.R. Designed for examining radio noise within the solar system—from the Sun, planets, etc.—it will also be capable of tracking satellites passing over the U.K. "with great accuracy and speed."

GAGARIN FILM. — A full-length feature film commemorating the first manned orbital flight is being made at Russia's Central Studio of Documentary Films. Apart from depicting Yuri Gagarin's early life, sequences showing preparations for the flight have been shot by the Moscow Studio of Scientific Films.

Commercial Aviation Affairs

NEW OPERATOR.—Wg. Cdr. H. C. Kennard, D.F.C., who resigned as joint managing director of Silver City Airways last November, is to form a new airline operating company (so far unnamed) with its base at Rochester Airport. Operations are due to start next year and equipment will consist initially of "twin-engined turboprop aircraft" for all passenger services. Rochester is a grass aerodrome with a maximum run of 4,700 ft.; it is operated by Short Brothers and Harland.

CALEDONIAN COMPANY.—A new company has been set up to operate inclusive tours and general charters from Prestwick. Named Caledonian Airways (Prestwick), Ltd., it plans to purchase two DC-6Bs and expects to begin operations towards the end of this year.

200 BOEINGS.—Lufthansa took delivery of the 200th Boeing jet airliner on Apr. 28. It was a 720B—the second of eight ordered by Lufthansa—and represents the half-way mark of Boeing jet transport production on the basis of 400 firm orders to date.

CUNARD EAGLE'S 707s.—Subject to a favourable answer to its North Atlantic licence application, Cunard Eagle Airways has placed a conditional order for two Boeing 707-420s so that early delivery will be possible. Initial plans are for a daily North Atlantic service.

CORONADO TRIALS. — A third Convair 990, bearing American Airlines markings, entered the flight test stage early this month. Two more, to fly in the next two months, will also be used in the trials. The first 990 recently resumed flight trials with shortened outer pylons. Deliveries to American Airlines are to begin in November.

INTERNATIONAL CODE.—A universal standard interline message format has been adopted by the member airlines of IATA and the U.S. Air Transport Association, to permit the linking of electronic data processing equipment used for airline reservations throughout the World. It will come into use on Oct. 1.

MEXICAN TAKE-OVER?—A syndicate has been formed to take over the shares of Guest Aerovias Mexico owned by S.A.S. and Mr. Winston Guest. The idea is to make this airline, which is the only one with European and South American traffic rights, an all-Mexican business.

FAIRCHILD F-27F. — Fairchild recently resumed production of the Fokker Friendship to assemble a small batch of F-27Fs for corporate owners. This variant has Dart 529-7E engines and many items of equipment previously offered as optional extras.

CL-44 PERFORMANCE.—Measured figures for the production CL-44s for Seaboard and Flying Tiger show a 6% greater range, a 3½% higher cruising speed and an 11-12% reduction in runway requirements in relation to the original guarantees. Take-off distance at max. weight is now 6,800 ft. and landing distance at max. weight is now 5,980 ft. There has also been a saving of 1,500 lb. in guaranteed weight. The CL-44 will go into North Atlantic service with Seaboard (now Seaboard World Airlines) on Jly 1.

UNITED DME. — Distance-measuring equipment is to be installed by United Air Lines on all its jet aircraft by Dec. 1 this year. The company has ordered 138 DME airborne units from Collins Radio at a cost of more than $1 million.

DC-8 CERTIFICATE.—The Series 50 version of the DC-8, with JT3D-1 turbofans, was certificated by the F.A.A. at the end of April.

News About People

R.Ae.S. PRIZE WINNERS.—Left to right: Prof. D. B. Spalding (Simms Gold Medal); Lt. Cdr. D. J. Whitehead (Branch Prize); A. J. Troughton (George Taylor (Australia) Gold Medal); and T. W. F. Moore (Usborne Memorial Prize). Not present for presentation were C. Bourque and Prof. B. G. Newman (Edward Busk Memorial Prize); Prof. W. H. Wittrick (Orville Wright Prize); and J. S. Alford (Herbert Akroyd Stuart Memorial Prize).

LADIES ONLY.—Presented each year to a British woman pilot for a noteworthy achievement in aviation, the Jean Lennox Bird Trophy for 1960 has gone to Miss Sheila Scott. Lord Brabazon made the presentation at the Kronfeld Club on May 4. The selection panel considered that no one particular achievement during 1960 justified the award of the Brabazon Cup.

JOINING B.A.C.—Air Chief Marshal Sir Hubert Patch has joined the British Aircraft Corporation as its NATO representative. (See page 522.)

T.W.A. CHAIRMAN.—Mr. Ernest R. Breech has been elected chairman of Trans World Airlines following the retirement of Mr. Warren Lee Pierson.

HONOURED. — Mr. E. S. Calvert, senior principal scientific officer, R.A.E., Farnborough, was presented with the Monsanto Aviation Safety Award by the U.S. Aviation and Space Writers Association in New York on May 4. This was in recognition of his contribution to air safety in the development of the line and bar approach lighting system and the visual glide path indicator.

AVIATION MANAGER.—The Goodyear Tyre and Rubber Co. (Great Britain), Ltd., has appointed Mr. A. Hughes manager of its aviation division, in succession to Mr. M. G. Foulger.

SPERRY SALES.—In succession to Mr. C. A. Richardson, who is now director of export sales of the recently formed Sperry Europe Continental Co., Mr. J. D. Stevenson has been appointed manager, aero sales, of the Sperry Gyroscope Co., Ltd.

The S.B.A.C. education and training panel at Blackburn Aircraft recently. Back row, l. to r., J. C. Raettig (Blackburn); E. W. Leat (Bristol Siddeley); F. A. B. Gaire (Handley Page); J. T. Dilon-Godfray (D.H. Aircraft); J. W. Jennings (Vickers-Armstrongs); L. E. Holton (Hawker); W. M. Watford (D.H. Engines); L. S. T. Brown (D.H. Aircraft); Col. C. E. Thompson (Shorts); J. W. Caswell (Hunting). Front row, l. to r., J. Daley (English Electric); E. Duckett (Vickers-Armstrongs); R. Willmott (assistant secretary); T. A. Wolstenholme (Blackburn); W. H. Daniels (chairman); F. C. Kirkpatrick (Folland) and J. B. Rilett (Bristol).

Air Transport

Skyways Plans for Avro 748s

SKYWAYS COACH AIR, LTD., was the first registered customer for the Avro 748 airliner, although the contract was not formally concluded until last week, on May 3, when it was signed by Mr. Eric Rylands and Mr. J. A. R. Kay. Valued at approximately £750,000, the contract is for three Avro 748s, including the first production aircraft, due to fly in August. After delivery in the autumn of this year, this 748 will be used for route proving by Skyways crews over the coach-air network. The other two 748s will be delivered in time for regular services to start from Lympne in the spring of 1962.

The Skyways Avro 748s are 44-seaters, to match the capacity of coaches now coming into use, and are expected to help in reducing the journey time between Victoria, London and Paris, to 5 hours; with DC-3s used at present, it is 5¼ hours. The aircraft will be fully committed to Skyways Coach Air operations, which will include some inclusive tour work, for an annual utilization of 1,200-1,500 hours. The lack of night flying facilities at Lympne, the grass-field terminal for coach-air services, limits utilization.

Commenting on the contract, Mr. Eric Rylands said last week that Skyways expects to carry 100,000 coach-air passengers this year, and if traffic continues to increase at its present rate they will probably order one more Avro 748 each in 1963 and 1964. As many as 80% of the coach-air passengers are under 25, many of them students and many flying for the first time. The coach-air DC-3s will be kept for general charter flying and freighting. Skyways would also be interested, Mr. Rylands said, in buying A.W. Argosies for its freighting services if suitable new licences could be obtained. The company already has a licence to fly a freight service to Moscow, but has not yet been able to obtain Russian approval for this.

The two prototypes of the Avro 748 have now flown about 450 hours, and the certificate of airworthiness should be obtained by September. Towards the end of next month the second aircraft (G-ARAY) will be going to the Middle East (probably Cyprus) for tropical trials, and will then be converted to the prototype Series 2. In Skyways livery and fully furnished, the first production Series I will be seen at Farnborough in September before delivery to Skyways; the second aircraft on the line is the first for Aerolineas Argentinas, to be delivered in October. Deliveries to B.K.S. will also begin before the end of the year; this company's contract for five should be signed in the course of the next few weeks.

A.T.C. Speed Limit

AFTER the New York collision last December—in which one of the two aircraft involved, the DC-8, overshot its holding pattern—the U.S. Federal Aviation Agency suggested that more effective local speed limits might be enforced.

It is now proposed by the F.A.A. that all arriving aircraft operating below 14,500 ft. and within 50 miles of the destination airport should reduce speed to 250 kt. The rule will apply under IFR and VFR in both controlled and uncontrolled airspace. Only those aircraft, such as military turbojets, which are unable to operate safely below this speed, will be exempt from the rule. The 14,500-ft. upper limit coincides with the base of the U.S. continental control area.

This proposal follows one, drafted last year by the F.A.A., in which a restriction to 156 kt. would be generally applied to aircraft operating within a specially defined traffic area (5-mile radius below 2,000 ft.) at all tower-equipped airports.

Increased B.O.A.C. Profit—and Loss

PROVISIONAL figures given by B.O.A.C. for 1960-61 show that a record profit of £4.75 million on the Corporation's own operations was more than offset by a loss of £1.8 million in respect of the associated companies. The year can variously be regarded as good or bad, and the daily newspapers on May 5 ran through the whole range of opinion, from *The Times*' "Record B.O.A.C. Profit" to *The Guardian's* "B.O.A.C. Doubles its Loss."

The operating profit was about £500,000 better than in the previous year, but all except £100,000 of this profit was needed to pay interest on Government loans; the comparable 1959-60 residual figure was £277,000. Operations of B.O.A.C.'s associated airlines led to a deficit of £1.8 million, or more than double the 1959-60 figure, so the overall B.O.A.C. result is expected to be a loss of some £1.7 million.

One of the heartening features of the year's results was a decrease of 3d. in costs per capacity ton-mile, which came down to 30d. Three years ago the figure was 39d. Traffic during the year increased by 30%, with passenger-miles up from 1,835 million to 2,500 million and traffic revenue up from £70 million to £88.5 million. Net earnings of foreign currencies totalled £29 million after payment of local expenses; most of the dollar earnings during the year were applied towards the purchase of Boeing 707s.

Commenting on the results of the associated companies, Sir Matthew Slattery said: "The position in regard to some of these companies is far from satisfactory. Every effort is being made to remedy the situation, but the taking of positive steps is made difficult by political and other considerations and it should not be thought that the necessary improvements in financial results can be effected quickly."

In the 1961-62 year, B.O.A.C. is increasing capacity overall by 35%, with a 42% increase on the Atlantic routes. For the first time the sales target is well over £100 million.

BRITAIN'S NEWEST.—A model of the British Aircraft Corporation's new short-haul jet airliner, the One-Eleven. Details of this Rolls-Royce Spey-engined successor to the Viscount are given on page 509 of this issue. It will be delivered to B.U.A. in 1964.

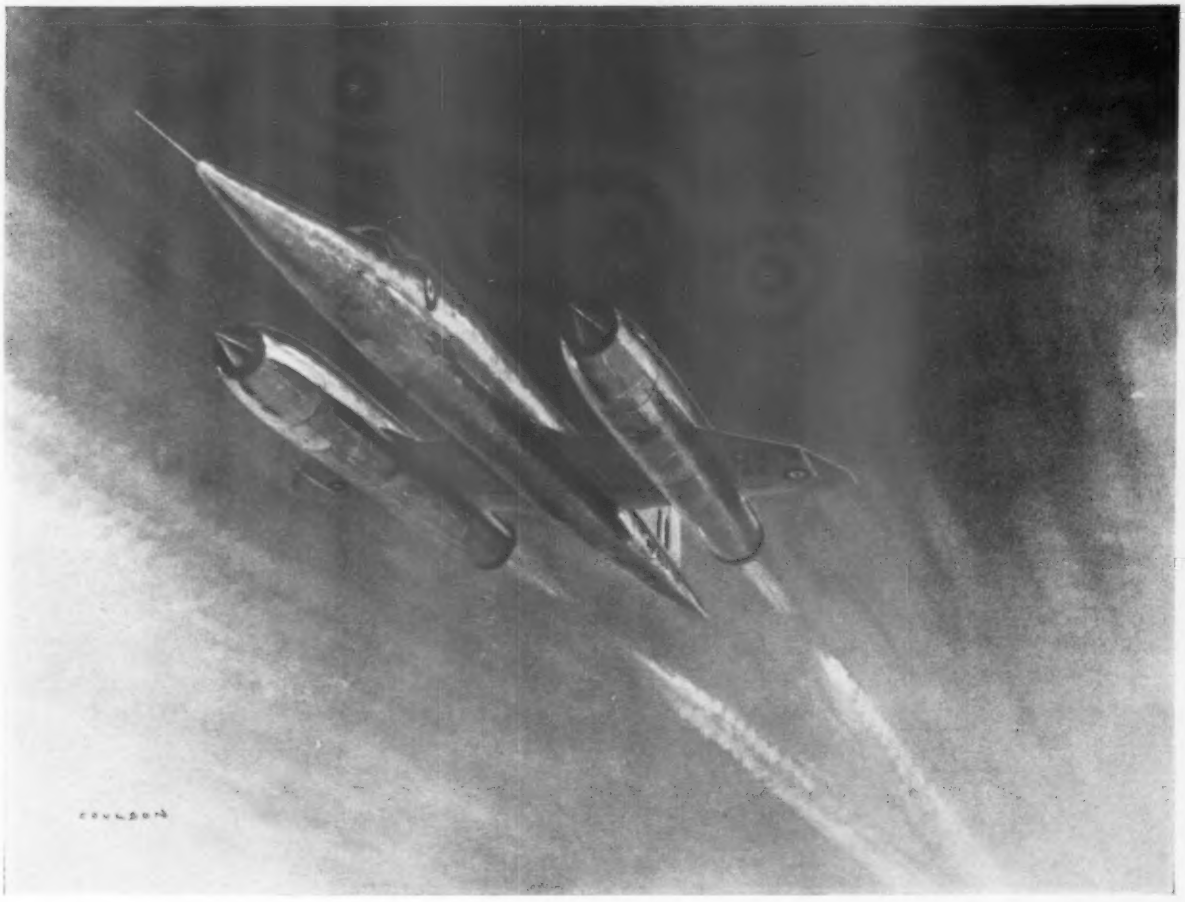
The World's Biggest Airline

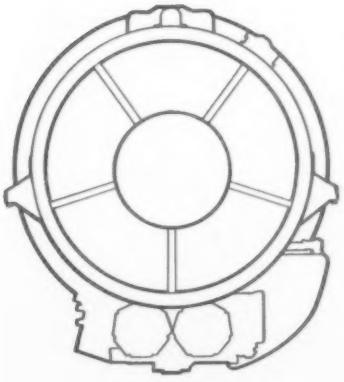
ON Jne. 1 United Air Lines will become the World's biggest airline, measured by capacity ton-miles flown. On that date the United-Capital merger—approved earlier this year by the C.A.B.—is expected to become effective. On Jly. 1 it is planned to initiate combined schedules over the new United system, which, as a result of the merger, will increase from approximately 12,000 to 18,000 unduplicated route miles serving 117 cities within the U.S.A.

According to the airline, the combined schedules will increase by 30% the seating capacity provided individually by the two companies a year ago. The increase will result from delivery of new jet aircraft and use of larger aircraft on some of the former Capital segments. In 1960 Capital offered some 327 million capacity ton-miles and United offered 1,197 million. If the United statement is taken to mean that a 30% increase is to be made in c.t.m., the total in 1961/62 will approach 2,000 million. In 1960 American Airlines was the biggest airline, producing 1,348 million c.t.m.

The combined United fleet will total 267 aircraft on Jne. 1, made up as follows: 37 DC-8, 18 Boeing 720, 41 Viscount, 39 DC-7, 89 DC-6/6B (including 11 leased from Pan American), 27 Convair 340, three DC-3 and 13 DC-7A/DC-6A freighters. On order are three DC-8 Series 50, 11 Boeing 720, 40 Boeing 727 and 20 Caravelle; the last-mentioned will enter service in July.

From Jne. 1 the name United will gradually replace that of Capital on all equipment and in all references to the airline. The 41 Viscounts will be repainted and are also to undergo "extensive interior refurbishment." Company headquarters will be in a new $7-million building near O'Hare International, Chicago.





de Havilland GYRON JUNIOR engines power the new Bristol T188 high supersonic research aircraft.

The de Havilland Engine Company Limited
Member Company of the Hawker Siddeley Group

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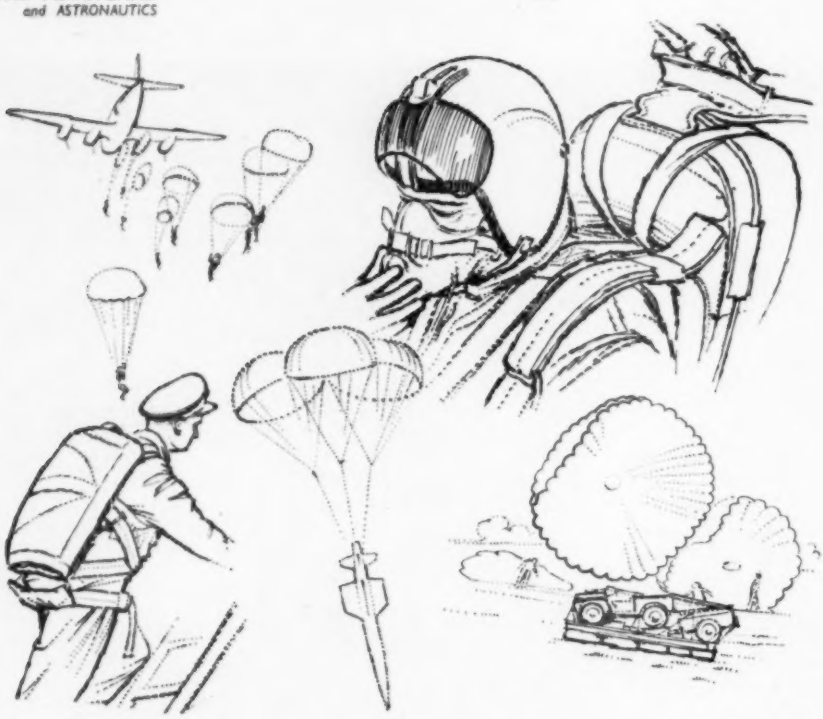
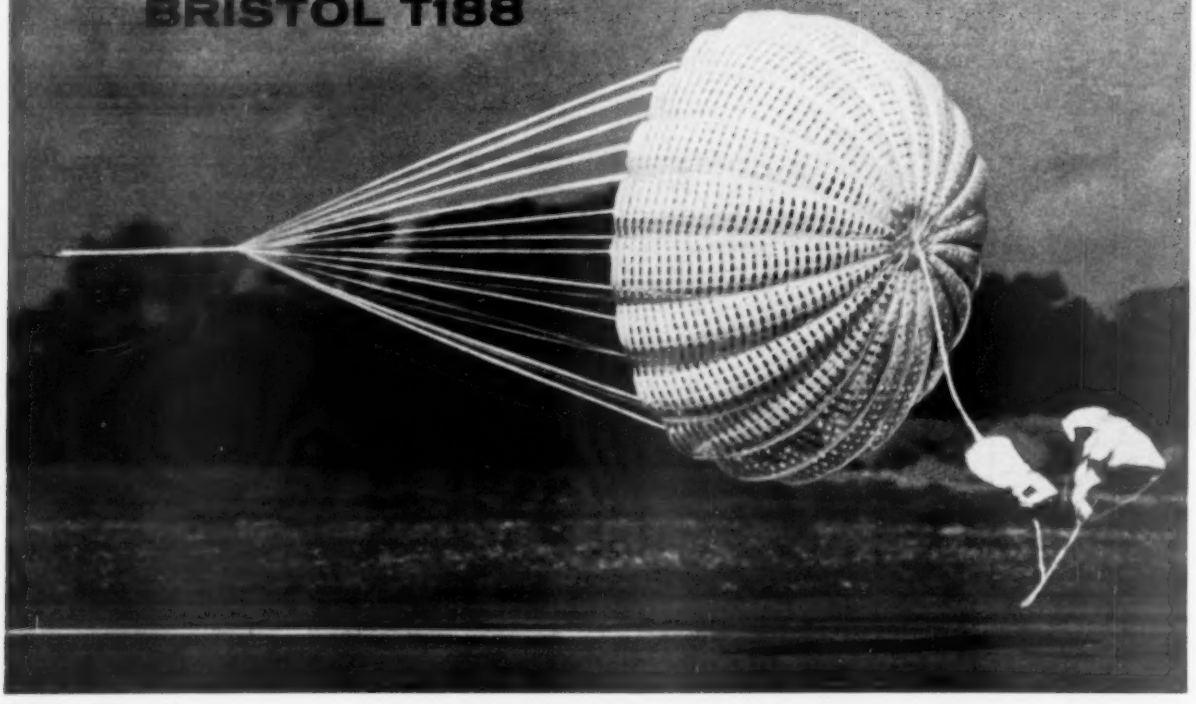


There is an
IRVIN parachute
for every purpose

IRVING are the designers and manufacturers of landing brake and anti-spin parachutes for the BRISTOL T188



Irving Air Chute of Great Britain Ltd · Letchworth · Herts · England · Telephone: Letchworth 888 · Telegraphic Address: Irvin, Letchworth

Air Transport . . . .

MANCHESTER'S NEW TERMINAL.—The control tower section of Ringway's new terminal building is now complete and, as the picture on the right shows, in use by the traffic controllers. Steelwork for the passenger section of the terminal can be seen to the left of the tower in the picture below.

Photographs copyright "The Aeroplane and Astronautics"

The T.W.A. Jet Orders

TRANS WORLD AIRLINES' orders for 30 additional Boeing jet transports, recorded in our previous issue, brings this company's total fleet of four-jet airliners, delivered or on order, to 77, including 20 Convair 880s and 57 assorted Boeing 707s and 720s. Only one airline to date has ordered more four-engined jets—B.O.A.C. The Corporation's jet purchases total 79, made up of 19 Comet 4s, 15 Boeing 707s and 45 Vickers VC10s. American Airlines has purchased 76 four-jet transports, only one less than T.W.A. The largest jet fleet on order is that of United Airlines, which has purchased 40 DC-8s, 29 Boeing 720s, 40 three-engined Boeing 727s and 20 twin-engined Caravelles, making a total of 129; additional Boeing 720s are soon to be ordered.

T.W.A. will use its six new 707-331Bs on transatlantic services. This variant has 18,000 lb. JT3D-3 turbofans, new leading and trailing edge flaps and a small wing span extension; its range in still air with full tanks is said to be 7,200 naut. miles. An interesting feature of the T.W.A. orders is that the 20 707-131Bs and the four 720Bs (the latter leased from Boeing) will also have the JT3D-3 engines, whereas versions of these aircraft ordered by other airlines have the 17,000 lb. JT3D-1. These aircraft are intended for domestic routes within the U.S.A. Delivery of the 131Bs will take place from March to October, 1962, and of the 331Bs from July to September, 1962. The 720Bs are to be delivered by September, 1961.

The new orders, valued at $187 million, are understood to have been financed by bank and insurance company loans. T.W.A. has only recently completed arrangements to finance its fleet of 20 Convair 880s, the last of which will be delivered in August; the financing of this order and T.W.A.'s re-equipment needs in general were the key factors leading to Howard Hughes' loss of control of T.W.A. last December (see our issue for Dec. 30). Mr. Charles C. Tillinghast, T.W.A.'s new president, said last month that purchase of a short-haul jet transport and of a jet freighter were longer-term projects.

Capital for S.A.S.

THE joint governmental committee which has been examining the financial situation of Scandinavian Airlines System has recommended the provision of about £14,500,000 of new capital. This, it is proposed, will be provided, as before, in ratios of 3 : 2 : 2 by the Governments and private enterprise of Sweden, Norway and Denmark, the sponsoring nations, with Sweden therefore providing about £6,210,000 and Norway and Denmark about £4,145,000 each. The last capital provisions for S.A.S. were made in 1950 for about £11 million; last year's losses were about £5.7 million.

As we reported in the issue of Feb. 24 (p. 198), S.A.S. has been going through a difficult time. A loss of about £3.5 million is expected during the current financial year and no surplus can be expected before about 1964. The causes of the recent deficit have included the restrictions in traffic rights, the costs of turbojet service introduction, the delay in the delivery of DC-8s, the difficulty of selling outdated equipment (DC-7Cs in particular), losses in the now-terminated association with Guest Aerovias Mexico (about £3.5 million invested) and the costs involved in the building of a new hotel in Copenhagen.

But S.A.S.'s fundamental trouble has been concerned with increasing national protectionism and the consequent difficulty of maintaining the necessary traffic-growth.

Licensing News

CUNARD EAGLE AIRWAYS' application for a licence to fly a scheduled transatlantic passenger service will now be heard by the A.T.L.B. at a public hearing starting at 2.30 p.m. on May 16 and continuing on the next two days if necessary. This will be the first hearing of a major application for rights in direct competition with either of the airline Corporations, and it is, of course, opposed by B.O.A.C. As announced last week, the hearings for the series of European, African and Asian applications will begin on Jne. 20.

Applications for new air service licences include one from B.E.A. for a service between London and Marseilles. B.O.A.C. are seeking permission to serve Kuwait on their routes to Tokyo, Hong Kong and Singapore. Derby Aviation has requested permission to serve Ibiza as well as Palma on its service from Cardiff/Bristol/Exeter, and specifies the DC-4, Argonaut, DC-6 and Viscount as operational equipment for this service.

Details have been given by the Board of its secretariat staff. Mr. J. E. Barnes, the secretary, is aided by a deputy secretary, Mr. D. H. Isaacs, and an economist, Mr. R. E. Johnson. The work of the secretariat is divided into four sections. Section 1 (Miss P. B. Woodcock) deals with statistics, tariff questions and Class C and F applications; Section 2 (Mr. H. J. West) is concerned with Class A, B, D and E licences for the U.K., Channel Islands, Isle of Man, Eire and France; Section 3 (Miss M. L. Hill) with Class A, B, D and E licences in all other areas; and Section 4 (Mr. R. G. Cook) deals with administrative matters and records.

Russian Roof-top Heliport

A HELIPORT (or vertodrome, to use the Russian word) is to be constructed on the roof of the new Moscow main post office building near the Kazan railway station. It is to be used by Mi-4 helicopters which will operate to and from Moscow's airfields by day and night.

Situated on the top of the 12-storey building, there will be two landing and take-off strips—197 ft. by 82 ft. and 197 ft. by 56 ft.—a parking area, and small buildings for control and flying personnel. The parking area will be equipped with tethering points for testing engines of helicopters in the hovering or tethered state.

The landing areas will be floodlit and the boundaries will be marked by white lamps; green lights, pointing upwards, will indicate the centre of each landing area.—F.J.F.

Air Transport . . . .

Talking about Air Freight

THE terms of reference for last week's B.O.A.C./B.E.A. air freight symposium* might fairly be summarized by saying that it, and the "presentations" concerned, were designed to help to answer this question: how can the components of the air-freight business be co-ordinated so that it can become an uninterrupted, smoothly running operation?

The various answers showed that the means were becoming available for the streamlining of warehouse and apron-handling techniques and for air transport at steadily reducing costs, but that the integration and standardization of these means had still to be achieved. Furthermore, the answers showed that there were a number of difficulties hidden behind the relatively simple (if somewhat expensive) mechanized solutions to handling and associated problems.

For instance, the ideal situation, in which goods might flow in palletized loads all the way through from the factory to the destination, is very far from ideal when the details are examined. International shipments could involve the need for Customs clearance at the factory; the loads would have to be very strongly contained to cope with the rough treatment likely to be met in intervening road and rail transport; and the shipments might need to be broken down at the airport terminal in order to meet individual aircraft floor-strength and C.G. limitations. Furthermore, a pallet is, when locked in position, an integral part of the aircraft and damage or distortion could seriously delay the loading operation at the airport.

It seems obvious, too, that packaging and handling techniques must be capable of effective use with existing converted passenger aircraft while being capable also of modification and expansion to deal with the big-capacity aircraft and with increasing volumes of freight. Agreement on a pallet size suited to all normal freighter fuselage/door/floor dimensions will be necessary.

Discussions of the economics of pre-packed containers suggested that these were well worth their weight on short-medium-haul services, where fast turnrounds were important and where fuel weights did not limit the payload, but that on very long-haul services the loss of payload could be serious. However, on such services turnround times are likely, for various reasons, to be fairly prolonged and loading times may be less critical.

Nobody at the meeting questioned the actual physical practicability of the palletizing of assorted loads. Presumably it must be a reasonable proposition—though one is made suspicious by artists' impressions in which beautifully squared loads appear to have been made possible only because all the components in the load are rectangular solids. However, one or two speakers did mention the need to limit the height of each palletized load because of the risk of crushing the items at the bottom of the heap, and a depth of 6 ft. or so seemed to be an acceptable maximum. Another speaker considered that the shippers might be given some kind of template (or "measuring cup") for a series of smaller packages so that these could be conveniently built into multiples when being palletized for transport at the airport terminal.

Given the loads, the incentive and the cash, there are no obvious technical difficulties about designing and building a very advanced type of freight terminal—such as the one in use at Tinker A.F.B., Oklahoma City (described and illustrated at the meeting), which covers 44,000 sq. ft., is completely mechanized and is designed to deal with the processing and movement of about 90,000 tons of freight per annum. The problem seems to be to design a terminal which can deal effectively and economically with present freight-traffic volumes, yet be capable of continued development and expansion to meet traffic increases, variations in shipment characteristics and changes in aircraft design.

Apparent differences of opinion about whether a combined military/civil freighter project could be a success in either rôle were cleared when the distinction between tactical and strategic military requirements was explained. Thus, a freighter designed for MATS—the operations of which are essentially "civil" in character—could be a commercially satisfactory aircraft, whereas one designed to meet tactical and strategic requirements (such as one for the R.A.F.) could not be so. Hence the probability that the C-141—a U.S.A.F./F.A.A. compromise—will be a good aeroplane for the commercial operators.

Although the A.W. Argosy had its "think" beginnings in an R.A.F. requirement, the design was developed in the knowledge that the civil and military demands could not be matched. A twin-boom layout permitted the use of a different fuselage in the military version—which, largely because of special requirements, is 10,000 lb. heavier than the civil Argosy. Similarly the military Short Belfast (see an earlier page in this issue) is now being offered for civil use with two decks in its over-capacious fuselage, with the deletion of the rear doors (which are heavy and restrict the effective fuselage capacity), and with a hinged nose.

The consideration of requirements led naturally to the thought that a really specialized freighter could be made much more effective by the deletion of doors, escape hatches and windows—which involve a considerable weight penalty. Unfortunately, the airline industry is not yet prepared for such uncompromised fleet units—which might, in any case, need be offered later for sale to operators with other than all-freight ideas. There will not be much advantage in deleting the transparencies (as with the early windowless DC-6As for American Airlines)—a properly uncompromised freighter is likely to involve the fairly basic redesign of a fuselage in which cut-outs and their associated structures are just not considered. It will surely be a different beast almost from the moment of the initiation of project design.

And that seems to epitomize the situation for the airline operators as well as for the aircraft manufacturers in this matter of the so-called (and long-promised) air-freight breakthrough. —H.A.T.

* B.O.A.C./B.E.A. Integrated Air Cargo Systems Presentation. Individual presentations were given by Armstrong Whitworth Aircraft (Mr. E. D. Keen); by the Lockheed Aircraft Corporation (Mr. R. F. Stoessel); by Short Brothers and Harland (Mr. H. G. Conway); and (on automatic conveyor systems) by the Alvey Ferguson Co. of Cincinnati (Mr. C. J. Becker). Chairmen were Mr. D. O. Bustard (general traffic manager, B.O.A.C.) and Mr. E. P. Whitfield (traffic director, B.E.A.).

Air Ceylon in Review

THE future of Ceylon's international air services will be reviewed by the Government in the near future. The agreement concluded six years ago with K.L.M. for technical collaboration and assistance will shortly expire, and various alternative arrangements have been suggested. If the K.L.M. agreement is not renewed, Ceylon might either attempt to continue its present pattern of international services unaided, or concentrate only on regional and domestic services while developing Katunayake and Ratmalana airports to make them more attractive to foreign operators.

The former of these two possible courses would call for the acquisition of new equipment by Air Ceylon. At present the international services are flown by a Lockheed Electra on long-term lease from K.L.M., and a provisional order has been placed by Air Ceylon for an aircraft of this type in order to continue services after the K.L.M. aircraft is withdrawn. Our correspondent in Ceylon reports that some aircraft manufacturers have offered Air Ceylon favourable deferred terms for new aircraft. The Electra is used for a weekly return service between Singapore, Colombo and Amsterdam, by way of India, Pakistan, Cairo, Rome and London.

Mr. Bunny Molamure has recently been appointed general manager of Air Ceylon, and Mr. M. F. de S. Jayaratne, now permanent secretary to the Ministry of Defence and External Affairs, is expected to become chairman of the board.

The New Moscow Airport

MORE information is now available on the new Moscow-Domodedovo airport.

The apron area will take up to 14 aircraft and passengers will enter the aircraft direct from their channel by special telescopic galleries adjustable for the aircraft entrance height. A. A. Arnold, the chief engineer, states that the airport will have a passenger-handling capacity greater than that of the three other Moscow airports together. There are 36 channels in the passenger-handling hall. Domodedovo's traffic, it is stated, will nowhere intersect with that of Bykhovo, Vnukovo, or Sheremetievo airports.—F.J.F.

Aviation in Hungary

By the Editor

Ferihegy Airport.

IN the past fortnight inaugural flights have been made between Budapest and London by B.E.A. and Malev, the Hungarian State Airline. On Apr. 17 a party headed by Lord Douglas, chairman of B.E.A., and accompanied by His Excellency the Hungarian Ambassador Bela Szilagyi, arrived in Budapest by way of Prague in a B.E.A. Viscount. During his stay Lord Douglas laid a wreath on the monument in Red Hero Square. A week later a Hungarian delegation headed by Rudolf Ronai, Director of Civil Aviation at the Hungarian Ministry of Communications, arrived in London accompanied by Mr. S. Huvos, managing director of Malev, with numerous Government officials. They travelled by one of the three Il-18 turboprops now operated by Malev.

The opening of the service by B.E.A. is a reminder that this national air corporation now serves more than 80 principal cities in 30 countries in Europe and the Middle East. It carries some 4,000,000 passengers a year over a network stretching from Bergen in the North to Doha (Qatar) in the Persian Gulf in the South and from Moscow in the East to Lisbon in the West.

Malev, as is to be expected of the State Airline of a country of 10 million inhabitants, is a rather smaller concern, but the opening of the link to London is significant. It is likely to have a considerable influence on the European traffic pattern since the link between London and Budapest is the longest in the Malev network and the decision has understandably been taken to route so far as possible all transatlantic traffic in and out of Hungary through London. The pooling arrangements between Malev and B.E.A. are still being negotiated, but this policy decision must be mutually advantageous.

By taking advantage of an opportunity to travel on the inaugural trip it was possible to gain, even on a brief visit to Budapest and the shores of Europe's largest inland sheet of water, Lake Balaton, some idea of modern Hungary. These impressions, combined with officially provided facts, enable one to see how it is that a country, once so predominantly agricultural, is anxious to improve its air communications with the rest of the World.

Mr. Ronai, Director of Civil Aviation in Hungary, at London Airport with H.E. the Hungarian Ambassador Mr. Szilagyi, on his right, and the managing director of Malev, Mr. Huvos, on his left.

Malev is a well-established concern, but before examining its present organization and set-up it will be as well briefly to review the situation of Hungary today. It is quite a small country stretching 166 miles in the north-south direction and 328 miles east to west. On its borders lie the Soviet Union, Rumania, Yugoslavia, Austria and Czechoslovakia.

As 9.98 million people live on its 35,918 sq. miles of territory, the density works out at 275 inhabitants per sq. mile, which compares with a figure of 770 for this country. It is mostly plain and has no very high mountains, indeed the highest is 3,329 ft. Communications by air are thus favoured.

Formerly relying on a mainly agricultural economy, conditions have so changed that today 62% of the national income is derived from industry and only 32% from agriculture. It hardly needs to be said that among the aims of the centralized planning is an increase of exported manufactured products. This increase is to be observed in various fields and one of the most successful covers the production of diesel-engined motor-coaches. But exports are not only to be found in light engineering products, pharmaceutical materials such as antibiotics and morphine, of which Hungary claims to be one of the biggest exporters, are produced. By way of contrast it is to be noted that Hungary has the biggest aluminium industry, among what are described as the people's democracies. Increasing quantities of Hungarian wine are being exported. Improved communications are needed to develop business with the outside world.

It seems reasonable to expect a growing tourist business. Unlike other countries behind what used to be called the Iron Curtain, Hungary, at least so far as Budapest and Lake Balaton are concerned, has got plenty to offer the tourist. Hungarians enjoy their food and wine; cafés and restaurants are easy to find and are pleasantly situated. Zigeuner bands are famous. But as everywhere else tourist traffic is bound to be seasonable. In winter Lake Balaton, which in summer is one vast expanse of bathing beaches and camps, can be frozen many inches deep.

As we said earlier, the topography of Hungary is such as to make flying straightforward and though distances are short, the fact that one-fifth of the country's population lives in and around Budapest makes it desirable to operate a series of services radially arranged in and out of Budapest. Seven towns are served. These are Miskolc, Debrecen, Nyiregyhaza, Szeged, Pecs, Szombathely and Zalaegerszeg.

In the course of the visit, I had the good fortune to talk with the Director of Civil Aviation, Rudolf Ronai. In the course of this, Mr. Ronai pointed out that at the end of the War Hungary found herself with no aviation at all. Aerodromes and equipment all had gone. In 1946 an agreement was signed with Soviet Russia whereby equipment was provided and pilots trained. There was a dearth of engineers and to provide the necessary teams of skilled men, engineers were trained in Russia. After six years a start was made with international

An Il-18 of Malev in front of the twin control towers at Ferihegy Airport, Budapest. Only one tower is used.

traffic and in 1953 the network was expanded. In 1953 air traffic agreements were signed with the Scandinavian countries, Belgium, Holland, Austria and France. Proposals to regulate traffic between Great Britain and Hungary were first made, Mr. Ronai told me, three years ago. By 1957 Il-14 aircraft were in operation and last year three Il-18 were obtained. Today these aircraft are operating services between Budapest and Moscow, Berlin, Prague, Warsaw, Belgrade, Bucharest, Sofia and Tirana. Even more capitals in the western countries have services, namely Stockholm, Copenhagen, Amsterdam, Brussels, Frankfurt, Zürich, Vienna, Rome, Paris and most recently to London.

This last-mentioned line between Budapest and London makes an intermediate call at Brussels. The parallel twice-weekly B.E.A. service between London and Budapest runs via Prague. The Malev service is being operated with tourist-class Il-18 turboprop aircraft arranged to carry up to 89 passengers. The same aircraft are used for the twice-weekly services running both ways between Budapest, Prague and Amsterdam and Budapest, Frankfurt and Paris. It is an interesting fact that the once-weekly service with the Malev Il-18 between Budapest and Tirana by way of Rome is the only direct link between Tirana and Western Europe.

However, to return to the interview with Mr. Ronai, it was pointed out that with such a network traffic figures are naturally interesting and though the figures in the official handbook are sparse, Mr. Ronai gave me the following figures which had been prepared for his talks in London. They refer to Ferihegy airport, Budapest, and compare the years 1958 and 1960:—

	1958	1960
Number of aircraft arriving and taking off ..	9,828	19,393
Passengers in and out	242,593	359,370
Network (km.) 1957	5,019	14,045

Since 1957 the number of transit passengers have increased three-fold.

Besides the towns mentioned earlier there is a civil aerodrome on the southern shore of Lake Balaton at Siofok. Bearing in mind in particular the excellent equipment at Ferihegy to which reference will be made later, I asked Mr. Ronai whether executive aircraft were welcome in Hungary and received the answer that was to be expected, namely that indeed they were. Mr. Ronai was careful to explain that a necessary proviso must be that visiting pilots must be experienced in the matter of flying airways and using the appropriate navigational aids; quite clearly it was necessary for civil aircraft to keep within the prescribed corridors. I emphasized the importance of business concerns being able to complete the necessary procedure in the shortest possible time and was told that formalities should not take more than five days.

Ten miles out of Budapest, with which it is linked by a high-speed motorway, Ferihegy Airport has an impressive approach to the stone-built terminal buildings and inside the passenger finds himself in a lofty marble-lined hall. Laid out to have the plan form of an Li-2 aeroplane, the airport buildings are unusual in that they possess two control towers, necessary in the plan view to simulate engine nacelles; but the realities of airport life are such that only one tower is used.

There is a single runway just under 10,000 ft. in length with Calvert approach lighting at one end. There are three NDB, ILS and radar.

Malev's fleet today consists of three Il-18s, nine Il-14s and numerous Li-2s. All are maintained at the airport, though a new heated hangar is being erected for the Il-18s. Engine overhauls are done on the site and though a turbine was out of one Il-18 on our arrival there were no signs of turbine maintenance in the shop which I visited. I was given to understand that hours between overhaul of the Ivchenko powerplants, which were quoted by the Russian engineers during my visit to Moscow at 400, have gone up, but no precise figures were available.

The airport buildings are equipped with good hotel facilities and restaurants so that transit passengers have no need to go into town and can be comfortably housed on the spot. Inspection showed the rooms to be well and comfortably furnished. The restaurants, as we were to find from experience, can provide the most excellent meals. I had a conducted tour of the kitchens and among their spotless and shining equipment one could see not only meals being prepared for the restaurants but being put up into trays and containers for the aircraft themselves. As Mr. Ronai told me, the geographical situation of Budapest is such as to make the transit traffic increasingly important and in building this up such facilities play their part.

There are 14 internal services a day. Nine airlines besides Malev use Budapest, their services either going on through to other capitals or providing direct services. The airlines concerned are:—Aeroflot, A.U.A., B.E.A., C.S.A., D.L.H./Interflug, K.L.M., LOT, TABSO and TAROM.

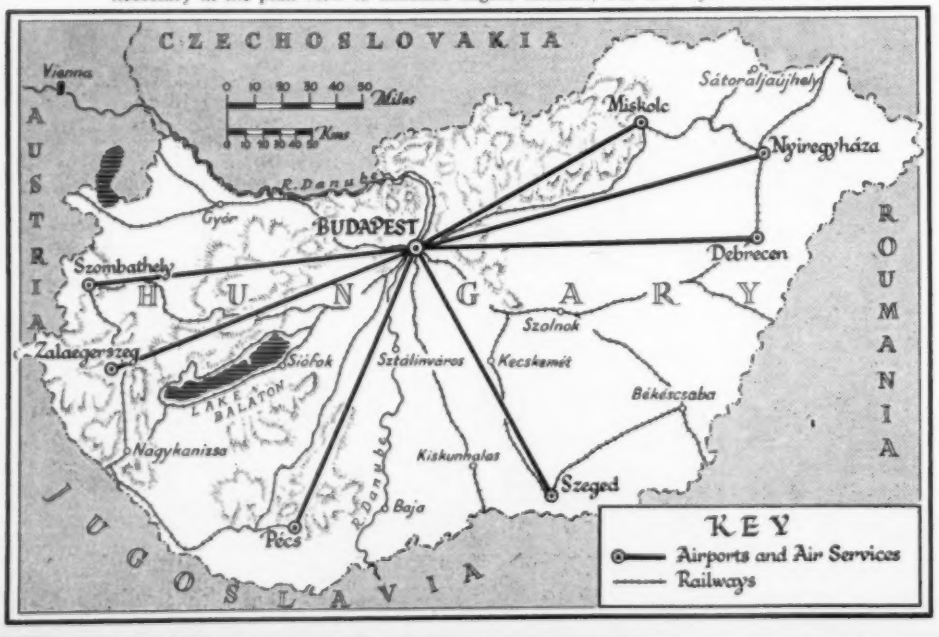
A number of visitors on this trip returned to England on the Malev inaugural service, which gave them a chance to travel in the Il-18. These machines are impressively laid out to carry 15 passengers in the forward compartment, 55 in the central cabin and 14 aft. The tourist seating is certainly no more cramped than its western counterparts. Passengers familiar with western aircraft will be hard put to identify the emergency exits, of which there are four in the central cabin, since they are not identified in any way nor does there seem to be a public address system. On this first trip there were no life-jackets for the Channel crossing, though canvas chutes for emergency descent from the fuselage are provided.

A crew of seven is carried; five men on the flight deck, two pilots, a navigator, a radio operator and a flight engineer who sits between and behind the pilots on a jump seat. The two stewardesses who have a splendid galley and plenty of space for hanging coats and hand baggage, travel aft. There are two lavatories forward and one aft. Noise level in the plane of the airscrews is as high as is to be expected of turboprops but as is also to be expected this area of the fuselage is used for the baggage hold. The freight hold which stretches beneath the fuselage is capacious.

Officials of Malev are confident that the freight-carrying capacity of the Il-18 is going to be much used and the carriage of food and fruit and vegetables is customary. As has been said earlier, Hungary is building up her export business and, if air freight can help to improve deliveries to a customer, one can be sure that Hungary's State Airline is going to provide just that service.

In the cockpit, the Il-18 is well provided with flight aids. Not only have the crew Doppler navigating equipment but they are also particularly proud of their radar anti-collision gear. This gives audible and visible warning of aircraft on a collision course within a range of 30 miles ahead. The usual airborne search radar can then be utilized to identify the position of the aircraft ahead.

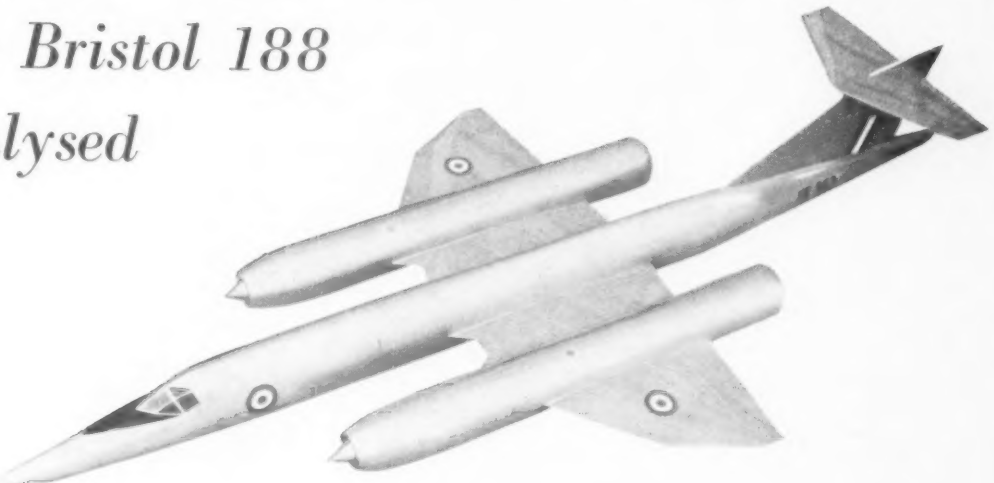
Mr. Ronai, who travelled in the later machine to London and was on the flight deck on the approach to London Airport, made a particular point during a conversation after his arrival in London to express his warm appreciation of the services rendered by the controllers at London Airport.



The seven towns served by regular Malev daily services are shown on this map. Foreign aircraft have to keep to strictly defined corridors, the four of which radiate from Budapest.

Britain's Mach-3 Research Aircraft

The Bristol 188 Analysed



ROLL-OUT of the first Bristol 188 supersonic research aircraft for engine runs took place on Apr. 26 and its first flight from Filton is expected later this summer. It is, therefore, a timely moment to survey the development and aims of this important aircraft—which is the first developed in Britain capable of flight at Mach 3. As such it should prove invaluable in the years ahead for kinetic-heating studies and the evaluation and proving of airframe structures, powerplants and systems suitable for high-supersonic aircraft. Two Bristol 188s are being built.

No official date has been given for the start of work on the Bristol 188, but its development programme goes back into the early 1950s. The first mention of the 188 was made in evidence before the 1956 Select Committee on Estimates when it was described as a "straight thin-wing aircraft built in steel." In a list of research projects discussed by the committee it came between the Rolls-Royce "Flying Bedstead" Thrust Measuring Rig and the Short SC.1 VTOL aircraft.

A design and development contract for the SC.1 was placed in August, 1954, and that for the 188 was earlier, probably at least seven years ago. Another fact confirming this date is that Mr. D. I. Vickery, who has been associated with the 188 since the project began, was appointed design manager, Type 188, in March, 1954.

According to the company, "In its original design the Bristol 188 was influenced not only by requirements for structural and aerodynamic research, but also for investigations of other propulsion systems. Some of these specialized aspects have since been modified but the aircraft, as it is now being built, is intended for flight research for a wide range of conditions."

At the time when the project was begun, it was inevitably intended for research applicable to future military aircraft. But the 1957 Defence White Paper dealt a death blow to certain military aircraft planned at that time, and must have removed some of the research aims for which the 188 was intended.

Rethinking of its rôle, coupled with changes in development priorities, must have delayed work on the aircraft. Moreover, the development of new materials and structural techniques has always been a long business. And it is no secret that the availability of a suitable powerplant has affected the project.

It is, then, not difficult to see why it has taken some seven years to bring a prototype to the flight stage. This has also been a costly programme; Dr. A. E. Russell, Bristol's technical director, has reported that the company's experience shows that a stainless-steel airframe costs at least twice as much per lb. as an aluminium-alloy one.

Design Details

The Bristol 188 specification called for a single-seat aircraft which would carry a large load of recording instruments. It was required to take off under its own power, climb to operating height, fly a research flight pattern and return to base; in this it differs from many American high-speed research aircraft, which have been air-launched.

The new aircraft was intended to fly at speeds approaching Mach 3 and was thus to have a steel structure to withstand the kinetic heating involved. Flight duration was to be sufficient for the study of steady-state conditions in aerodynamics and kinetic heating as well as transient phenomena. The project was expected to provide for as much versatility in the research rôle as possible.

To meet these requirements the 188 was designed with a stainless-steel airframe and it is powered by two de Havilland Gyron Junior DGJ.10 turbojets with afterburners. These powerplants are in separate nacelles mounted centrally on a thin wing—a layout which allows engine intake systems and propelling nozzles to be altered or replaced easily. The portion of the nacelle carrying wing loads can be detached from the inner and outer wings and a nacelle of a different size substituted. This proved fortunate, because interim engines were originally proposed when the design began and no suitable supersonic turbojet was then available.

The fuselage was designed to accommodate the pilot, in a small pressure cabin, instrumentation, fuel and most of the airframe services. In cross-section it is an oval, the area of which was kept as small as possible; limiting factors were the need to house the pilot near the nose and to retract the main undercarriage wheels into the centre fuselage. Only a slight waisting of the fuselage was necessary to meet area-rule aerodynamic requirements, because the position of the body relative to the wing and nacelles gives a fairly favourable distribution of cross-sectional areas.

The fuselage and nacelle layout was also designed to give favourable shockwave interaction at supersonic speed. Cascade-type airbrakes are installed in the rear fuselage.

The pilot has a Martin-Baker Mark R4 lightweight fully automatic ground-level ejection seat of the type in current production for many aircraft throughout the World. The aircraft's braking parachute, which is stowed in the fuselage tail cone, can also be used as an anti-spin parachute; it has a special 35,000-lb. release.

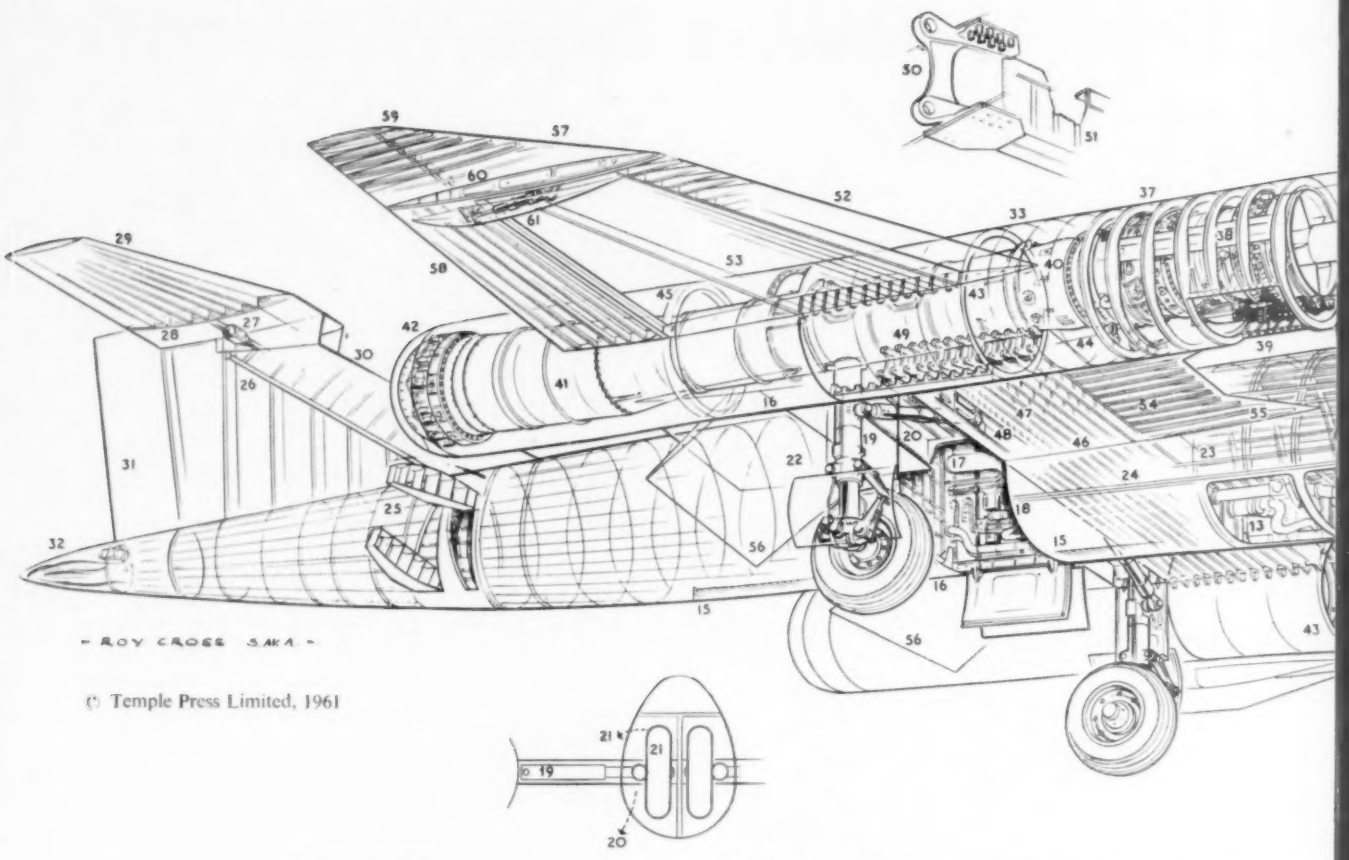
A very thin wing of modified bi-convex section was chosen for the Bristol 188. It has a thickness/chord ratio of 4% and it is thus only about 7 in. deep at its thickest point—which caused problems in stowing the undercarriage. The main leg occupies the whole depth of the wing and the wheels are retracted into the fuselage after rotation of their axles about the ends of the shock absorbers. This complication was considered necessary to meet the design requirements. The 188's undercarriage is of Dowty Rotol design.

Design Data

DIMENSIONS.—Span, 35 ft. 1 in.; overall length, 71 ft.; height, 13 ft. 4 in.; max. fuselage width, 3 ft. 9 in.; max. fuselage depth, 4 ft. 11½ in.; wing area, 396 sq. ft.

WEIGHTS.—Not available.

PERFORMANCE.—Aircraft designed for flight research at speeds up to Mach 3 (approx. 2,000 m.p.h. at heights above 36,000 ft.). Endurance sufficient for steady-state kinetic-heating conditions to be reached.



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BRISTOL 188—KEY

1. Hatch to forward instrument compartment.
2. Front pressure bulkhead.
3. Metal canopy with flat toughened-glass panels; glass with greater heat resistance to be used later in test programme.
4. Martin-Baker ejection seat.
5. Inner skin in cockpit area forms pressure-tight compartment.
6. Cockpit aft pressure bulkhead.
7. Nosewheel retracts forward.
8. Hatch to main pressurized test-instrument compartment; information is recorded in flight and also telemetered to ground stations.
9. Electrics panels.
10. Ducting for ventilation/refrigeration system.
11. Fuselage structure of "puddle-welded" skin-stringer-frame construction in stainless steel. Practically the whole airframe is of stainless steel to withstand temperatures up to 280° C. in high-speed flight.
12. Fuel tank compartment floor acts as stiffener against fuselage torsional stresses.
13. Service lines and ventilation system piping below fuel tank compartment floor.
14. Access panels to (13).
15. Central 27-ft. long keel stiffener in vicinity of main undercarriage doors and access panel cutouts.
16. Slight fuselage waisting opposite engine nacelles for area-rule aerodynamics.
17. Service lines grouped on central diaphragm/keel assembly to provide room for retracted main wheels.
18. Austenitic stainless-steel piping for hydraulic system, which operates undercarriage, flaps, air brakes and power controls.
19. Undercarriage main legs hinge at point adjacent to wing/nacelle joint (see detail).
20. Main undercarriage legs retract inwards, occupy full depth of wing.
21. Wheels pivot about shock struts, possibly in manner shown here, to retract inside the limited fuselage cross-sectional area.

The wing has a span of 35 ft. 1 in. and an area of 396 sq. ft. Between the fuselage and nacelles it is unswept and of constant chord, with trailing-edge flaps. Outboard of the engines the leading edge is swept 38° and the all-moving tips, which form the balance area of the ailerons, have a leading-edge sweep of 64°.

Effectively, the ailerons are a combination of all-moving wing tips and trailing-edge flaps. This arrangement was chosen to give effective rolling power at both subsonic and supersonic speeds with economy in control power.

An all-moving tailplane is mounted above the swept fin, which carries an orthodox constant-chord rudder. Two cascade-type airbrakes open out sideways from each side of the rear fuselage ahead of the fin.

Structure

First phase in the design of the 188 was devoted to structural work. Thorough studies were made of the range of alloys then available. The material chosen would have to withstand temperatures well over 200° C. during supersonic flight, but would experience rapid cooling on deceleration to subsonic speed when the temperature could fall to around −40° C. Cruising flight at Mach 2 in the stratosphere leads to steady skin temperatures of about 100° C., but at Mach 3 this "soaked" skin temperature rises to around 280° C. and even higher if the atmosphere is hotter than standard.

A study of material properties at high temperatures showed that stainless steels would be more suitable than other materials for the high-temperature structures needed. There was a long delay in the delivery of stainless steels, but a form of 12% Cr. steel was already in use for turbojet engines and austenitic steels were available in lower-strength wide-tolerance specifications, mainly for commercial uses. These have greater formability for double-curvature applications.

In collaboration with Bristol these materials were developed by Firth-Vickers Stainless Steels, Ltd., to give the properties required.

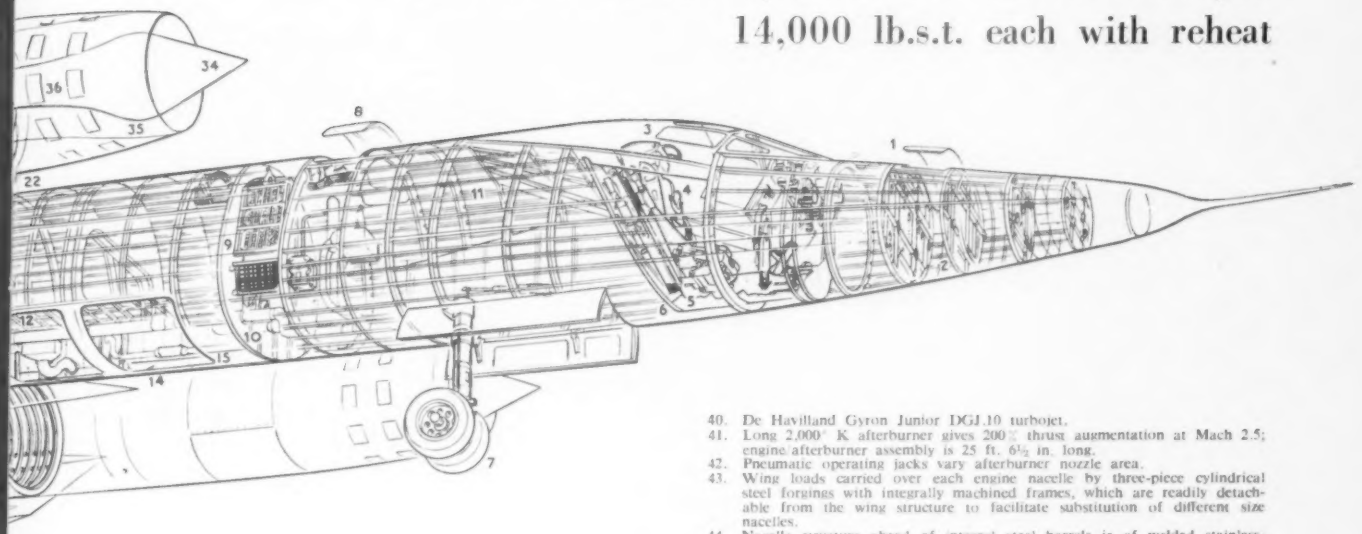
Two main classes of stainless steel were chosen for the 188. They are a 12% Cr. complex ferritic steel, in the 70 tons/sq. in. ultimate tensile strength range, and a titanium stabilized austenitic 18% chromium 8% nickel steel, Firth-Vickers FDP, of about 64 tons/sq. in. u.t.s. The 12% chromium stainless steel was of the Firth-Vickers F.V.448 type originally developed as a creep-resisting steel for gas turbines. Full details of Firth-Vickers materials development for the Bristol 188 were published in our issue of Aug. 19, 1960.

Because of the high strengths of sheet materials and high airframe loads, it was also necessary to develop a range of high-strength bolts, fastenings and forgings. Rivets in 12% chromium steel were satisfactory when fully hardened and tempered at 70 tons/sq. in. However, these could not be used in many parts of the airframe where access was limited because they are formed by squeeze and percussion methods.

Blind fasteners and patent rivets were eventually developed in suitable materials from current designs. These included Jo-bolt fasteners, which consist of a nut, bolt and deformable

Bristol 188 Supersonic Research Aircraft*

Two de Havilland Gyron Junior DGJ.10 turbojets 14,000 lb.s.t. each with reheat



22. Fuel tanks take up a large part of the fuselage space from well forward of the wing to well aft; fuel is used as a heat sink for equipment cooling.
23. Light alloy used for fuselage bulkheads cooled by contact with fuel.
24. Main wing spar structure passes right through fuselage.
25. Cascade-type air brakes open outwards from rear fuselage.
26. Main fin members support all-moving tailplane.
27. Hinge-point for power-operated all-moving tailplane.
28. Two machined ribs of forged steel form strong central torsionally stiff structure at highly stressed portion of all-moving tailplane.
29. Outer tailplane structure similar to wing structure, with multiple webs.
30. Fixed fin with 65° leading-edge sweep.
31. Constant-chord rudder.
32. Stowage for braking parachute.
33. Powerplant nacelles are some 30 ft. in length.
34. Centre-body intake cone, initially fixed, but presumably to be replaced by variable-position cone for very high-speed trials.
35. Air intake ducting interchangeable for various experimental installations.
36. Inward-opening intake valves in cowling augment airflow to engine at low speeds and during ground running. They also act as spill flaps to maintain proper shock wave pattern during high-speed flight.
37. Strong local frame structure to support engine.
38. Local longitudinal members pick up with main engine mounts.
39. Access panel to engine, fuel-control equipment, etc.
40. De Havilland Gyron Junior DGJ.10 turbojet.
41. Long 2,000° K afterburner gives 200% thrust augmentation at Mach 2.5; engine/afterburner assembly is 25 ft. 6½ in. long.
42. Pneumatic operating jacks vary afterburner nozzle area.
43. Wing loads carried over each engine nacelle by three-piece cylindrical steel forgings with integrally machined frames, which are readily detachable from the wing structure to facilitate substitution of different size nacelles.
44. Nacelle structure ahead of integral steel barrels is of welded stainless-steel skin-stringer-frame construction.
45. Extra-strong local frame to support wing rear spar.
46. Modified bi-convex wing section 4% thick; maximum thickness is approximately 7 inches.
47. Main wing structural box formed by multiple spars.
48. Forged channel-section rear spar member takes main undercarriage retracting jack.
49. Ultra high-tensile steel (110-120 tons/sq. in.) forgings attached to ends of spar webs are inserted into 13 sets of slots each side of nacelle barrels and fixed with chordwise bolts, forming main wing/nacelle attachments.
50. Spar end forging attached to spar web and bolted to surrounding skin (see detail).
51. Spar web construction with vertical corrugations to minimize restraint of skin expansion following heating.
52. Sweepback of wing leading edges outboard of nacelles is 38°.
53. Outer wing spar box is swept back to conform with leading edge sweep.
54. Spanwise compressive stresses are caused by rapid heating of thin leading-edge skin which is stabilized only by multiple chordwise ribs.
55. Wing leading-edge fillet smooths flow at fuselage and nacelle junction.
56. Trailing-edge flaps between fuselage and nacelles.
57. All-moving wing tips are integral with ailerons and act as horn balances.
58. Aileron structure based on spanwise members.
59. Chordwise stiffeners for aileron tip.
60. Strong machined ribs and heavier skinning strengthen joint between aileron structural sections.
61. Power-control jack for aileron operation.

* *This drawing is based on security-cleared photographs and technical information; to some extent it is speculative.*

sleeve; for the 188 these high-strength blind fasteners were made of heat-treated high-tensile stainless steel.

Most of the difficulties with mechanical fastenings were overcome by use of a local welding technique analogous to spot welding. Known as "puddle welding," it relies on the local fusion of the sheets of material beneath an electric arc automatically struck from an argon-shielded electrode. This is the main jointing technique used in the 188 airframe and can produce welds between materials from 0.3 in. to 0.012 in. thick.

Large or small welds can be produced in different combinations of materials by adjusting current flow and welding time. Shear strengths of about 6,000 lb. per weld are possible with the thickest material and the strength does not fall off greatly when there is a small gap between the sheets joined. Small and adaptable tools are used, allowing welds to be made inside structures no more than 0.5 in. deep.

Development of this process took some time and coincided with materials development and the design of the airframe, both of which it affected considerably. With the techniques used, skill is necessary both in design and production to avoid accumulations of the minute shrinkages and distortions which tend to occur at the welds.

Because steel was chosen for the 188 structure, thermal stresses are more severe than they would have been with a light-alloy structure. There are two reasons for this. One is that temperature differentials are greater for a given skin-temperature rise because the conductivity of steel is lower. The other is that the thermal stresses induced depend on the product of the modulus of elasticity and the coefficient of expansion. For 188 steels this product is approximately twice that for light alloy.

Many thermal problems were studied in designing the 188 airframe. These included the restraint on fuselage expansion caused by bulkheads, particularly those cooled by contact with fuel. This problem was minimized by using light alloy for the cool part of these bulkheads.

Another problem was the restriction of the spanwise expansion of wing and tailplane skins which is caused by spar webs. This was tackled by keeping the restraint low by using webs with vertical corrugations. The thinness of the wing helps by keeping temperature differences down, and so does the absence of fuel, which would add to the problem by acting as a heat sink.

During kinetic heating the longerons and wing inside the body tend to restrain the chordwise expansion of wing skins at the fuselage side. According to calculations, even after flight at high Mach numbers for 30 min., the wing inside the body will not have reached a steady temperature. But the chordwise compression stresses set up die away rapidly outboard of the fuselage and do not appear to cause major destabilization of the upper wing surface.

Cockpit transparencies were a particular problem. Glass is necessary because the temperatures are too high for plastics. Glasses are weak in tension and the cooling which results in deceleration from high speed is the most severe case, when

tension stresses set up on the outside as a result of cooling add to the stresses set up by cabin pressurization. If *g* is pulled during deceleration, air loads on the largest transparencies add to the tension stresses.

To cater for flight under the worst conditions a transparent material with a low expansion coefficient will be used; this is presumed to be fused silica. We understand that for earlier flight trials toughened glass panels will be used, and at a later stage panels of alumino-silicate glass.

Tyres capable of withstanding high temperatures were also required. Special heat-resistant Goodyear tyres, known as "Thermal" tyres, were supplied to withstand temperatures that would cause deterioration of conventional aircraft tyres. They eliminate the need for tyre-refrigeration equipment on the aircraft, so saving cost and space. The heat-resistance of these units comes as a result of new formulations in compounding and in the materials used in the carcass and tread. Goodyear also developed highly rated brakes for this project; these were necessary because of restricted retraction space and the need to meet emergency-stop requirements.

Structural Design

Details of the structure are given on the accompanying cutaway drawing. This drawing has had to be based on photographs of the aircraft's structure and somewhat limited security-cleared information; thus in some respects it is inevitably speculative.

The engine nacelle barrels are an interesting feature. The problem was to construct a ring-stiffened cylinder about 4 ft. in diameter and more than 5 ft. long; three barrels are joined to form the cylinder. After considerable development they were produced by Firth-Vickers as FV.448 forged rings and machined to form a thin shell with integral I-ring stiffeners. The shell and I-beam webs are machined to less than 0.1 in. at their thinnest points. The barrels then weigh between 171 and 270 lb. and the cost per lb. is less than that for fabricated sheet-metal components.

Each spar of the multi-spar wing lines up with a nacelle-barrel ring. Spar lugs are ultra high tensile steel forgings of 110-120 tons/sq. in. ultimate strength. Attachment bolts are of similar strength. Wing skins are machined all over and taper ground, their mean thickness varying from 0.10 in. to 0.01 in.

Tailplane construction is similar to that of the wing, but because its maximum depth is little over 3 in. there are no ribs in the spar box between root and tip.

Over most of the fuselage the load-carrying structure is made up by skins and stringers. But in fuel-tank regions there are removable panels for access to the systems under the tanks, and the bending loads here are concentrated in a central keel boom which continues between the main wheels.

Powerplant

De Havilland Engines have been developing the 10,000-lb. Gyron Junior DGJ.10 and its reheat system for the 188 under an M.o.A. contract since 1957. Although this engine is basically similar to earlier variants of the Gyron Junior, it incorporates a range of features to suit it for high supersonic propulsion of the Bristol 188. These include the use of steel and titanium for the compressor and a fuel-cooled oil cooler for the lubrication system. Control systems on the engine and reheat unit provide simultaneous control of compressor air bleed, variation of exhaust-nozzle geometry and the metering of fuel flow to the engine and afterburner.

In order to achieve good intake efficiency at high supersonic speeds, a variable air intake is necessary. Air is spilled off behind the intake proper to maintain the correct shock-wave pattern. A control system for this has been supplied by Joseph Lucas (Gas Turbine Equipment), Ltd.; it employs a reversible air turbine operating on the main engine compressor air to drive the spill flaps through gearing.

The air supply is controlled to maintain a constant shock-wave pattern. A velocity feed-back signal ensures stability despite the high rate of response required to safeguard the apparatus in the event, for instance, of an engine shut-down due to interruption of the fuel supply or other such occurrence. The control has to be very sensitive to achieve the necessary accuracy when pressures are low and yet has to stand up to the maximum high-temperature and high-pressure conditions.

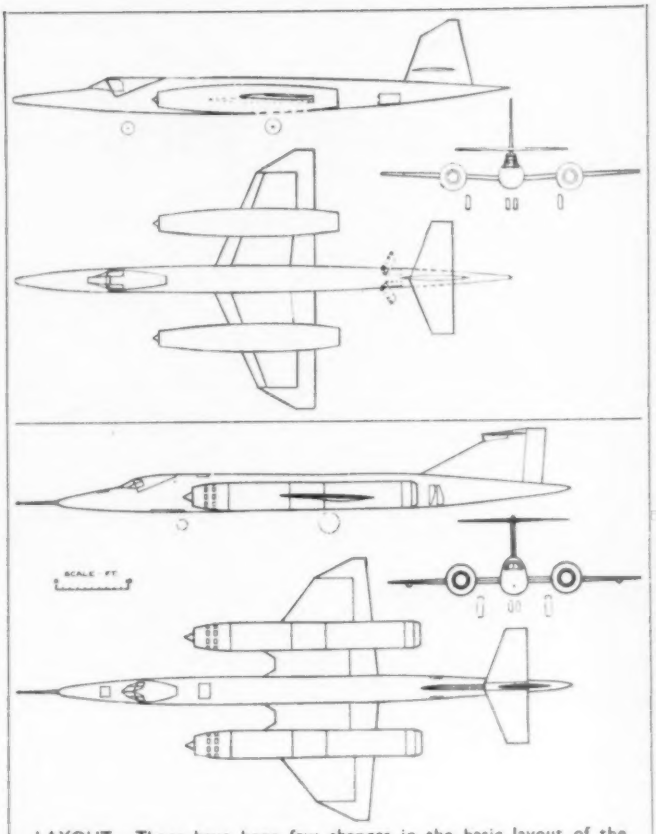
The reheat system operates at 2,000° K, boosting static thrust by 40% to 14,000 lb. At flight speeds of about Mach 2.5 it boosts the engine thrust by 200%. At 36,000 ft. and speeds above Mach 2.5 the total thrust is more than 20,000 lb. The multi-petal nozzle is convergent for subsonic and transonic flight, parallel for flight speeds up to Mach 1.4 with full reheat and opening to divergent for reheat flight at higher speeds.

The engine is being tested in the high-altitude supersonic test facility of the N.G.T.E. at Pyestock. This will allow its handling and performance to be assessed in conditions covering the full flight envelope of the Bristol 188.

Two of these engines with their reheat systems have been installed in a Gloster Javelin which first flew with them on Jan. 31. This will allow flight experience to be gained with the engine up to high subsonic speeds.

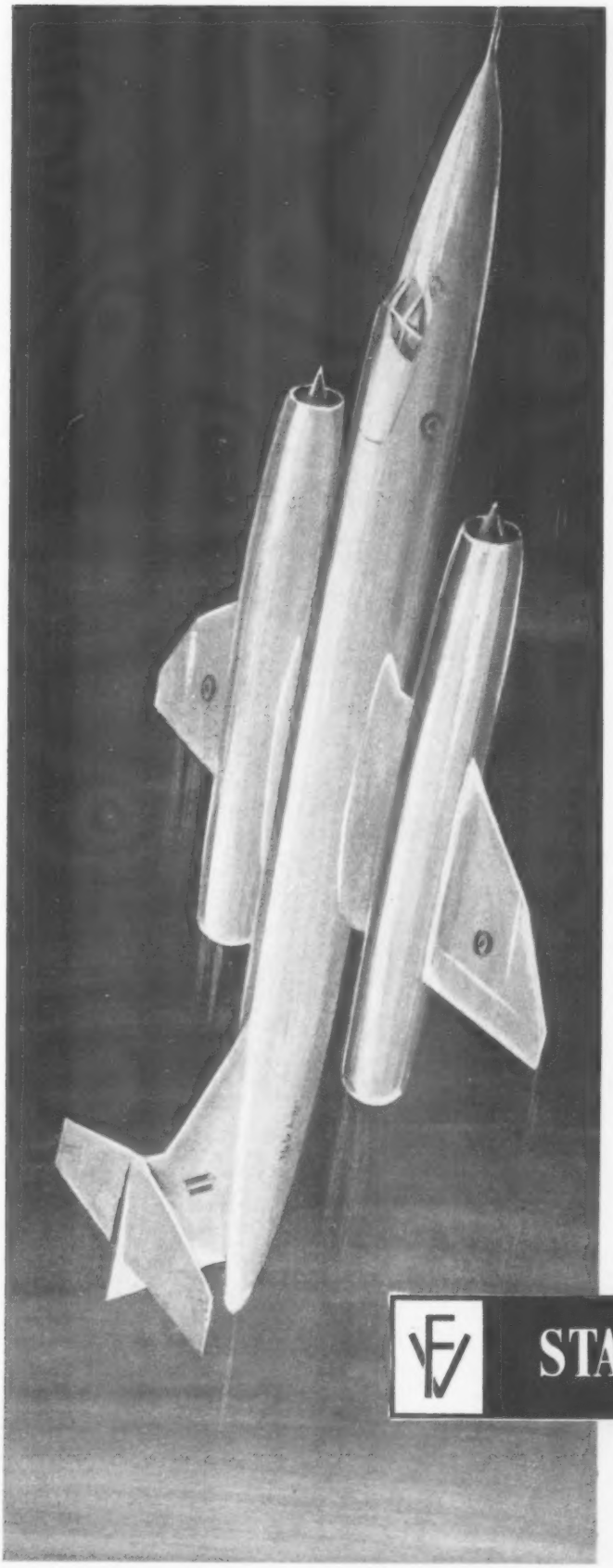
In designing and developing systems for the 188 a major

(*Continued on page 521*)



LAYOUT.—There have been few changes in the basic layout of the Bristol 188 since its design began. These general arrangement drawings show the original concept of the 188 and the aircraft as built.

ROLL-OUT.—The first Bristol 188 was rolled out prior to engine runs on Apr. 26.



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The continuous research and development of special Stainless, Heat and Creep-Resisting Steels carried out by Firth-Vickers since the early days of aviation has made possible the continual improvement in performance and efficiency both of airframes and engines.

This experience proved invaluable during the close co-operation between Firth-Vickers and Bristol Aircraft Limited when steels and methods of fabrication for the construction of the T.188 Supersonic Research Aircraft were considered.

Plate, Sheet, Bar and Forgings produced by Firth-Vickers account for over 90% of the Stainless Steel used in the construction of this aircraft.

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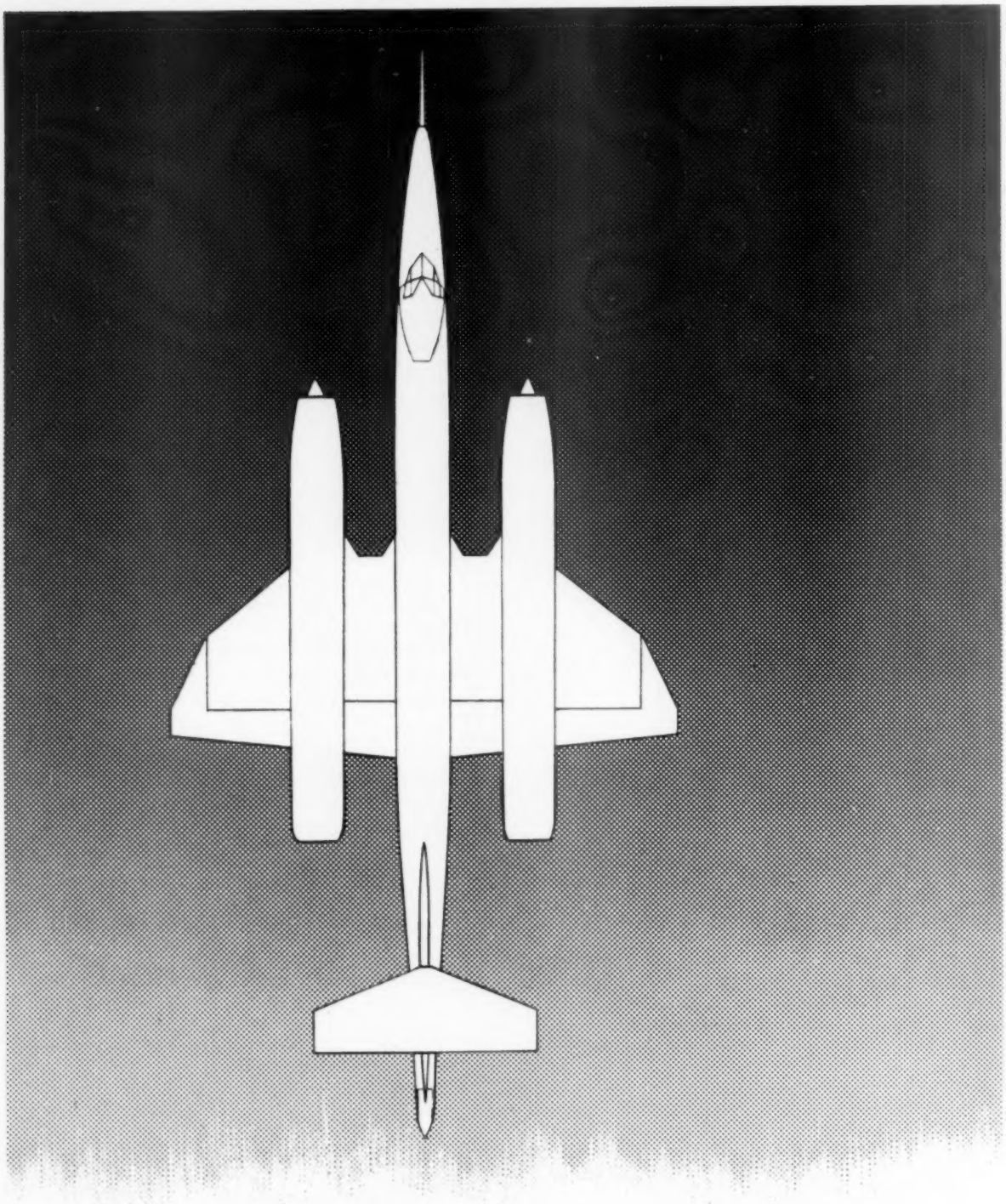


BRISTOL 188

Equipped with tyres, wheels, brakes, hydraulic control and anti-skid equipment by Goodyear

GOODYEAR

serving aviation the world over

AVIATION DIVISION·BUSHBURY·WOLVERHAMPTON

188 MEN.—Bristol Aircraft executives closely associated with the 188 are (left to right), Dr. A. E. Russell, technical director; Dr. W. J. Strang, chief engineer (aircraft); Mr. D. I. Vickery, assistant chief designer (aircraft); Mr. F. J. Chard, manager, manufacturing development department; and Mr. Godfrey Auty, chief test pilot. A lecture given by Mr. Vickery to the Cranfield Society provided much of the technical information given in this article.

(*Continued from page 520*)

requirement has been to keep the services, instrumentation and equipment as cool as possible during flight. Fuel has proved a convenient heat sink. To prevent the fuel entering the engines from being heated excessively, arrangements have been made to supply pre-cooled fuel to the aircraft. Fuel is used as a heat sink to cool hydraulic fluid and gearbox oil, electrical machinery and much instrumentation.

The fuel-supply system has proportionate flow control and there is controlled recirculation of fuel because of the wide range of the flow rates and altitudes at which the system must work.

High temperatures had an important influence on the design of the integral fuel tanks in the fuselage; sealants were a particular problem. Tanks were tested over representative flight cycles of temperature, pressure and fuel load. A fillet sealing treatment with successive coats of different sealants showed reasonable promise, but this technique was not developed before the aircraft design was well advanced.

The fuel-proportioner monitor unit and a flight instrumentation computer unit are supplied by H. M. Hobson, Ltd. Proportioned fuel flowing from each of the five tanks is continuously monitored and the information fed to an electronic computer unit connected to two cockpit indicators. One indicates the instantaneous percentage of fuel in the tanks and the other shows the total weight of remaining fuel in pounds.

Power controls, undercarriage and airbrakes are hydraulically operated. The temperature of the circulating hydraulic fluid is kept down by fuel cooling. This is only partly effective because many parts of the system are idle or moving at low flow rates when the aircraft is hot and the fluid can be heated to high temperatures locally.

Austenitic stainless steel tubing for the hydraulic system was supplied by Accles and Pollock, Ltd. The company also supplied larger diameter thin-wall stainless steel tubing for the aircraft's fuel and air systems.

Installation problems of the powered flying controls and large flows of hydraulic fluid at high pressure demanded the development of a range of rigid pipe joints, swivel joints and flexible pipes. Their development took a long time, because of the combination of a special fluid and the high temperature and pressure requirements.

The Boulton Paul powered flying controls have cable signalling systems with high-temperature cable tension regulators designed and manufactured by Teleflex Products, Ltd. The engine controls use the Teleflex remote control systems within the refrigerated cockpit area and then change to compensated cable systems for the high-temperature portions of the runs.

An orthodox electrical power generation system was chosen, with the components protected against severe conditions where necessary. The Rotax generation equipment used is air-turbine-driven; it is cooled and presents no special problem.

Many components, however, are subject to temperatures much greater than the development potential of current equipment and new types have been necessary. Mineral-insulated cables for the 188 have been produced by British Insulated Callender's Cables, Ltd.

A Normalair system is used for pressurization and air-conditioning. It operates on the regenerative air-cycle principle. Air tapped from the engine is used; it passes through a primary cooler in which cabin discharge air is the cooling medium. The air then enters the cabin via a water boiler and cold-air unit. The water boiler is essential at high altitude when the air mass flow through the system is at its lowest; water is an excellent refrigerant in these conditions. The boiler vents to atmosphere.

Air for the pilot's ventilated suit is normally supplied direct from the air entering the cabin, which is at an appropriate temperature and pressure. If the system fails, a cold supply from a compressed-air bottle is automatically switched on.

Development Tests

Structural tests are being made on a 188 airframe at the R.A.E., Farnborough. These will include transient heating tests on the complete airframe.

Some 20 wind-tunnel models were built to study aerodynamic and aeroelastic data on the aircraft's behaviour at both subsonic and supersonic speeds. Two of these models were exhibited on the Bristol stand at Farnborough last year; they were a $\frac{1}{3}$-scale half-wing for measurement of aileron hinge moments and a 1/36-scale model for stability measurements in the R.A.E 3 ft. × 3 ft. tunnel.

For the 188 a programme of free-flight flutter tests was made at Aberporth. For these, representative structure models were boosted by rockets for investigation at full-scale speeds. Information from the models was telemetered to the ground.

Flight Programme

The Bristol 188 will be flown by Mr. Godfrey Auty, the company's chief test pilot. The first flight will be made from Filton and the test programme will then be continued at the A. and A.E.E., Boscombe Down. After the basic characteristics and handling of the aircraft and its systems have been proved, flight speeds will be increased progressively to transonic and supersonic speeds. It will probably be many months before the aircraft is flown at speeds approaching Mach 3.

A great deal of information will be recorded in the aircraft for later analysis. Other information will be telemetered to the ground during flight and will be recorded for later analysis.

Although the 188 is somewhat outmoded aerodynamically—at least so far as supersonic airliners are concerned—it should prove an invaluable instrument for studying kinetic heating, and proving structural techniques, for high-speed aircraft. Experience with its airframe systems and tests with intakes, propulsion and reheat systems should provide useful information for the design of a British supersonic airliner. There should be little information lag between the teams involved in this work and the 188 design; both are headed by Dr. A. E. Russell.—J. R. COWNIE.

Bristol 188 Suppliers

This list of major suppliers for the Bristol 188 has been provided by Bristol Aircraft, Ltd.:—

Accles and Pollock, Ltd., stainless steel tube; The Airscrew and Jicwood, Ltd., cooling-system fans; Associated Electrical Industries, Ltd., ignition units; Aviation Developments, Ltd., Jo-bolts; Bristol Aerojet, Ltd., air and nitrogen bottles; British Insulated Callender's Cables, Ltd., high-temperature cables; Boulton Paul Aircraft, Ltd., powered flying controls; de Havilland Engine Co., Ltd., Gyron Junior turbojet engines; Dowty Rotol, Ltd., undercarriage and hydraulic equipment and air-turbine units; Dunlop Rubber Co., Ltd.; flexible pipes and hydraulic equipment.

Firth-Vickers Stainless Steel, Ltd., stainless-steel sheet, bar and tube; Sir George Godfrey and Partners, cold-air units and heat exchangers; Goodyear Tyre and Rubber Co., Ltd., wheels, tyres and brakes; H. M. Hobson, Ltd., electronic equipment; Irving Air Chute of Great Britain, Ltd., anti-spin parachutes; Lockheed Precision Products, Ltd., self-sealing couplings; Joseph Lucas (Gas Turbine Equipment), Ltd., variable-intake mechanism; Martin-Baker Aircraft Co., Ltd., ejection seats; M.L. Aviation Co., Ltd., parachute releases.

Normalair, Ltd., air-conditioning equipment; The Plessey Co., Ltd., plugs, sockets, relays and contactors; Power Auxiliaries, Ltd., flexible pipes; Pulsometer Engineering Co., Ltd., pumps; Rotax, Ltd., electrical generating equipment.

Saunders Valve Co., Ltd., fuel valves; Smiths Aircraft Instruments, Ltd., flight system equipment; The Solartron Electronic Group, Ltd., high-temperature transducers; Teddington Aircraft Controls, Ltd., air conditioning and pressurizing equipment; Teleflex Products, Ltd., aileron and flap control equipment; Thermal Controls Co., Ltd., fuel filters; Unbrako Socket Screw Co., Ltd., special bolts; Venner, Ltd., lightweight silver-zinc accumulators; Western Manufacturing (Reading), Ltd., solenoids.

The Fighting Services

R.A.F. Retirement

AIR CHIEF MARSHAL SIR HUBERT PATCH, K.C.B., C.B.E., chairman of the National Air Traffic Control Planning Group, is to retire from the R.A.F. this month.

Commissioned from Cranwell in 1925, he flew with Nos. 58, 45 and 12 Squadrons and in 1939 was on the armament staff at Headquarters, Bomber Command. He was appointed Director of Armament Requirements at the Air Ministry in 1943, and A.O.C., No. 44 (Transport) Group, the following year.

In June, 1946, Air Chief Marshal Patch went to Headquarters, Fighter Command, as Officer Commanding, Air Traffic Headquarters, but five months later became head of the Joint Aircraft Control Board under the (then) Ministry of Civil Aviation. In December, 1947, he was appointed Director of Operational Training at the Air Ministry, and in 1948 took over command of A. and A.E.E. In 1950 he became Air Officer-in-Charge of Administration of the Far East Air Force, after which he served as its Senior Air Staff Officer. From 1953 to 1955 he was Air Officer Commanding, No. 11 (Fighter) Group.

Appointed temporary A.O.C.-in-C., Fighter Command, in January, 1956, he became C.-in-C., Middle East Air Force, eight months later. In October, 1959, Sir Hubert took over the new appointment of Commander-in-Chief, British Forces Arabian Peninsula.

As recorded elsewhere in this issue, Air Chief Marshal Patch is to become the NATO representative of the British Aircraft Corporation with an office in Paris.

Air Rank Appointments

AIR VICE-MARSHAL C. BROUGHTON, C.B.E., is to become Director-General of Organization at the Air Ministry in June, and Air Vice-Marshal F. S. Stapleton, D.S.O., D.F.C., has been appointed Senior Air Staff Officer, Transport Command, with effect from next Monday.

A. V. M. Broughton has been Senior Air Staff Officer at Transport Command since May, 1958, and A. V. M. Stapleton has been Head of the United Kingdom Joint Services Liaison Staff in Canberra since February, 1959.

R.A.F. Gliding Effort

ASSEMBLED at Lasham last week for intensive training, the R.A.F. team for the 1961 National Gliding Championships (May 13-22) is the largest ever organized by the Service for this biannual contest.

Eight members of the R.A.F. Gliding and Soaring Association are flying Skylark 3-B and 3-F, and Olympia 460, 419 and 401-X high-performance sailplanes in League One, while 12 officers, N.C.Os and airmen will compete in League Two in Skylark 3-Fs, Olympia 460s and 2-Bs, and Eagles.

In League Two, several of the team are men without previous experience in a competition of the magnitude of these National Championships. Under a new scheme formulated by the R.A.F.G.S.A. to give valuable competition practice to N.C.O. and other pilots, they have been chosen in preference to other more experienced pilots. A number of other Service glider pilots are competing in the championships as individuals. The R.A.F. team comprises:—

League One: Gp. Capt. N. W. Kearon, O.B.E., Skylark 3-B; Wg. Cdr. J. G. Croshaw, A.F.C., Skylark 3-F; Sqn. Ldr. J. L. Bayley, Skylark 3-B; Flt. Lt. E. D. Cretney, Skylark 3-B; Flt. Lt. G. A. Coatesworth, Olympia 401-X; Flt. Lt. R. Dunn, Olympia 460; Sgt. J. Williamson, Olympia 419; Sgt. A. N. Gough, Olympia 460. **League Two:** Sqn. Ldr. E. T. Ware, Skylark 3-F; Flt. Lt. A. S. Loveland, Olympia 460; Flt. Lt. J. D. Spottiswood, Eagle; Flg. Off. J. Delafield, Eagle; Flt. Lt. E. W. Clarke, Olympia 2-B; Flt. Lt. C. McA.Bacon, Olympia 2-B; M. Eng. A. Eldridge, Olympia 2-B; Sgt. K. V. Newholme, Olympia 2-B; Sgt. P. E. Dawson, Eagle; Jnr. Tech. C. Taylor, Eagle; Jnr. Tech. J. R. Chandler, Olympia 2-B; Cpl. J. W. Pickles, Olympia 2-B.

SASSOON TROPHY.—Air Marshal Sir William MacDonald, A.O.C.-in-C., Near East Air Force, presents the Sassoon Trophy to Sqn. Ldr. D. Barfoot, C.O. of No. 249 Squadron.

No. 15 SQUADRON STANDARD.—H.R.H. the Duchess of Kent presenting a Standard to No. 15 Squadron at R.A.F. Cottesmore on May 3. Operating Victors, No. 15 is commanded by Wg. Cdr. J. G. Matthews, A.F.C.

N.E.A.F. Contest Results

FOR the second year in succession No. 249 Squadron (Sqn. Ldr. D. B. Barfoot) has won the Sassoon Trophy—a bombing and navigation competition for Near East Air Force Canberra squadrons. Runner-up was No. 32 Squadron (Sqn. Ldr. W. F. Knapper).

Winner of the N.E.A.F. bombing trophy was also No. 249 Squadron and the navigation award went to No. 32 Squadron. The contest was mounted from R.A.F. Akrotiri and occupied three days. No. 35 Squadron, Bomber Command, which entered as a guest competitor, was placed fourth in the Sassoon Trophy marking.

R.A.F. Appointments

THE following are among recent Royal Air Force appointments.

Air Ministry: Wg. Cdr. R. A. Jell, D.F.C., A.F.C., and Wg. Cdr. T. N. Staples, D.F.M., to the Department of the Chief of the Air Staff; Wg. Cdr. I. L. Dunn to the Department of the Air Member for Personnel; Wg. Cdr. W. H. Newman and Wg. Cdr. J. D. Mallinson, A.F.C., to the Department of the Air Member for Supply and Organization, the former with acting rank of Gp. Capt.

Bomber Command: Wg. Cdr. F. C. Airey, M.B.E., to R.A.F. Cottesmore as Senior Technical Officer; Sqn. Ldr. F. P. Walker, A.F.C., to Headquarters, No. 1 Group, for operations duties, with acting rank of Wing Commander.

Fighter Command: Gp. Capt. E. James, D.F.C., A.F.C., to R.A.F. Leeming to command.

Transport Command: Wg. Cdr. A. H. Simmonds, D.F.C., to Headquarters for work study duties.

Technical Training Command: Gp. Capt. A. P. Dart, D.S.O., D.F.C., to R.A.F. Jurby to command.

More Service News

R.A.A.F. Posting.—Air Cdre. F. Headlam has become A.O.C. of the R.A.A.F. Operational Command in succession to Air Vice-Marshal V. Hancock, with the rank of Air Vice-Marshal. A.V.M. Hancock becomes Chief of the Australian Air Staff at the end of this month.

Casavac Demonstration.—An R.A.F. artificial kidney unit was flown to Paris earlier this month for a lecture demonstration at the NATO annual medical conference on the rôle of the equipment in the treatment of casualties. Constructed by No. 248 Maintenance Unit at R.A.F. Chessington, the apparatus was first demonstrated to the B.M.A. in June, 1960.

Satellite Reconnaissance

By G. P. Coates,* D.L.C., A.F.I.A.S., F.B.I.S.

PROSPECTS of successful survey or reconnaissance from a satellite is a subject receiving a considerable amount of attention at the present time. The question most often posed in this connection is: "How much could be seen from a satellite using available equipment?" It is hoped that this article will answer this and some associated questions.

The considerable expense involved in the use of satellites for any purpose must be justified by the ability of the satellite system either to accomplish a task not feasible by any other method, or to achieve results of higher quality than is possible using any other system. Much survey and reconnaissance work is carried out from conventional aircraft; and so, to be of any use for this work, the satellite must be superior to the aircraft at least to an extent commensurate with the extra cost.

Three of the principal differences between the satellite and the aircraft are the greater height and speed of the former and, at the present time at least, its relative invulnerability to inspection or attack. The latter renders the satellite of obvious interest for use in military reconnaissance, whereas the superior height of the satellite makes it much more suitable than the aircraft for certain civil applications.

The most important civil use of reconnaissance satellites is in meteorological observation. Satellites could be employed to obtain meteorological data, such as cloud-cover photographs, on a scale not practicable by any other method and essential to long-range and extensive weather forecasting. In this connection the height of a satellite above the Earth's surface and its ability to operate continuously at such a height (thereby allowing a system giving world-wide coverage) are its chief assets.

The entire process of reconnaissance from a satellite can be regarded as consisting of two principal phases, the survey process, in which the satellite obtains information concerning the subject area, and the interrogation process in which this information in some convenient form is extracted from the satellite on command. Various methods are possible for both phases and these will be dealt with later.

Possible methods of data acquisition during reconnaissance are many and varied but in most of these information is recorded by some form of image-producing device. Only these processes and, as examples, the military and meteorological applications of them, will be considered here.

Orbits

The unperturbed orbits of Earth satellites lie in a plane which includes the Earth's centre and which does not rotate with the Earth. Thus the track on the Earth's surface vertically below the satellite depends upon the orbital parameters; in particular the ratio of the period of the orbit to the Earth's day (which may be progressively reduced by atmospheric retardation). This track is obviously of paramount importance in a reconnaissance system and hence the orbits of reconnaissance satellites will have to be chosen in the way best suited to the survey of a particular area of the Earth's surface or the atmosphere above it.

Orbits most suitable for reconnaissance satellites are probably the low ellipses. Perigee heights would be fixed by the limitation of satellite lifetime by atmospheric retardation and the decrease of resolution with height. Apogee heights would be fixed by consideration of the time required for satellite interrogation, the location of the interrogation stations, the power entailed, and by the effects of satellite orbit period on the time of coverage of a given area. These orbits have the advantage that results of low-altitude survey through perigee could be extracted during a much longer period of time through apogee.

Circular orbits could be used in cases where the same height for both data acquisition and interrogation purposes could be tolerated and have the advantage in practice that they permit a greater number of data-recording passes over the survey area in a given length of time than elliptic orbits do. Also, they enable a satellite to reveal less regarding its intentions than do elliptic orbits. Circular orbits could be used to advantage with the film recovery technique to be mentioned later.

Some idea of the coverage problem can be gained from the diagram which shows the tracks across the surface of the Earth of a satellite on a 150-mile perigee, 2,500-mile apogee polar orbit. This is a typical reconnaissance satellite orbit and it is clear that, particularly in the high resolution case, many passes would be required to cover any but the smallest areas.

Perturbations due to the Earth's oblateness will be significant in some cases and these would cause drifts in both latitude and longitude of perigee and apogee locations. These effects may not be too important in the case of the photographic satellite since the useful lifetime of such a satellite will be fixed by film storage capacity and will probably be too short for accumulated perturbations to have much effect.

The inclinations of orbits to the equatorial plane are important in the coverage programme. Only polar orbits cover the entire surface of the Earth, but inclinations less than 90° have advantages when it is desirable to traverse the subject area in a direction crossing the meridians at a large angle, and in certain other cases. Obviously the inclinations must be at least as great as the latitude of the survey area.

Launching

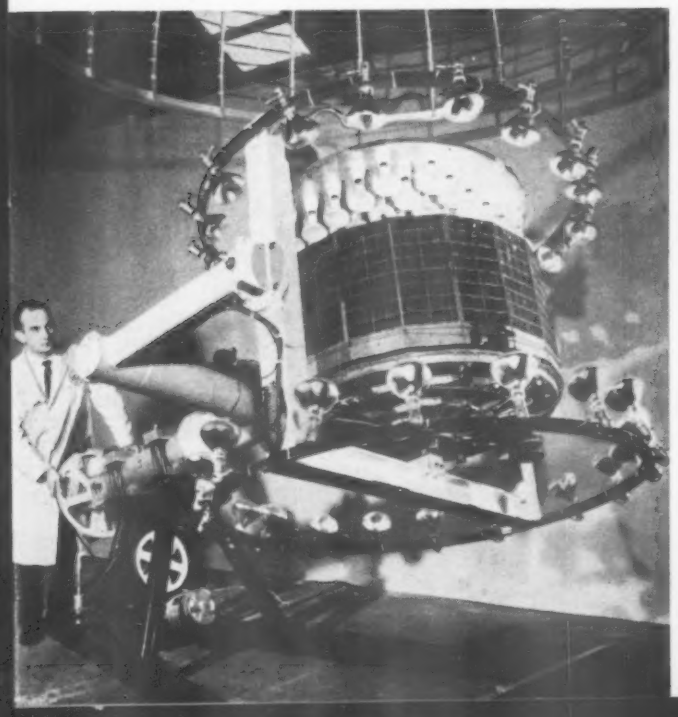
The launch of reconnaissance satellites would be conventional, except in the military case. Where perigee is required over hostile territory the satellite could either be injected into orbit at apogee, i.e., raised to apogee height and released with a horizontal velocity less than circling velocity by the amount necessary to establish the required perigee height; or the satellite could be launched into a circular orbit at perigee height, and then given further thrust during the first path through the target latitude to increase the horizontal velocity to the value necessary to raise the satellite to the required apogee height. The latter is the method that would normally be used as it is less economical to inject at apogee than to inject at perigee either directly or indirectly.

Survey and Interrogation Methods

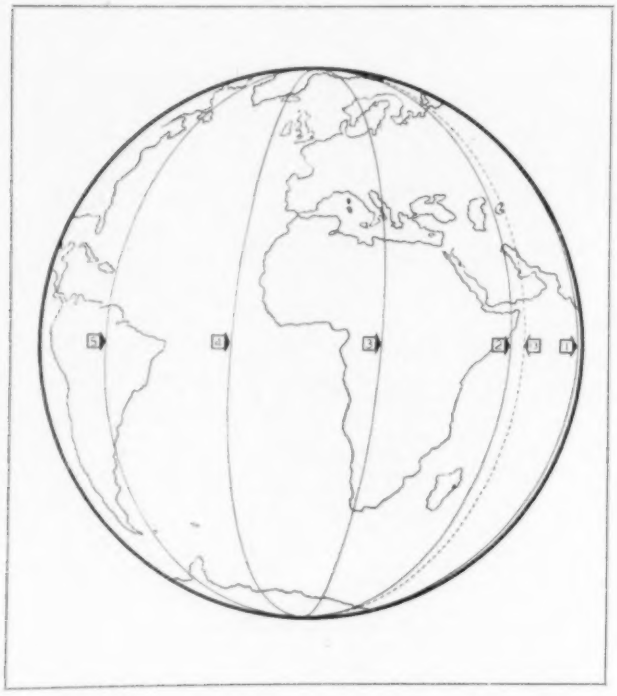
Survey from a satellite could be carried out using photography, television, infra-red methods or radar; interrogation of the satellite may be achieved using film scanning with telemetry, film recovery, television or telemetry.

Photography has the distinction of being able to produce resolutions higher than those obtainable with any other system, but is rather complicated and requires cloud-free daylight for its operation. Where applicable it also has the advantage of providing more information, in terms of numbers of picture

* Astronautics Section, Advanced Projects Group, Hawker Siddeley Aviation, Ltd.



Tiros II, second of the weather observation satellites launched by NASA, is seen here mounted in a special test rig which helps check the satellite's stabilization in conditions similar to those encountered in orbit. Lights on the rig permit the testing of solar cells on top and sides of the satellite.



Tracks over the Earth's surface of a satellite pursuing a polar orbit with a perigee of 150 miles and an apogee of 2,500 miles. The wide spacing of the tracks demonstrates the problem involved in attempting to cover a large area with strips that may be only 20 miles wide. On orbits 7-11 inclusive, perigee would occur over that part of the Earth not seen in the diagram, while orbits 6-11 would occur too close to the limbs to be shown. Orbit 13, the track of which is indicated by the broken line, occurs rather more than one day later than the first track. Perigee occurs over a latitude of 52° N.

elements, per unit of weight or per unit of cost than any other system. This and other systems requiring special subject conditions, e.g., cloud-free daylight, would require a sensing device to command operation or inhibition of the main data acquisition system.

Using a lens system 4-5-ft. focal length with suitable film and conditions, and perigee heights of 100 to 150 miles, it should be possible to see objects the size of motor vehicles and in certain conditions, e.g., in parks or on roads, to distinguish them as such. The shape of an object, as well as its size, and its contrast with the background all contribute to the resolution obtainable with the photographic system, in addition to lens focal length and freedom from aberrations, film emulsion type and so on.

Television yields resolutions considerably poorer than those obtainable using photography but is a simpler system. It requires more power for its operation than a comparable photographic system.

Resolutions readily achievable are sufficient to meet meteorological requirements, but the system is open to considerable development and may well provide much useful military information in the future. Television is, therefore, an obvious choice of system for a meteorological satellite, and the American Tiros satellites employ this medium, using either direct transmission or magnetic tape storage of results before transmission.

Radar, apart from its great advantage of being independent of sunlight and clear weather, has little to recommend it as a direct medium for reconnaissance from satellites—at least, with present minimum beam angles. Resolutions obtainable would be useless for most purposes and very large and heavy equipment would be required.

One possible application for a radar system would be the measurement of the absorption of high-frequency transmission by water in the atmosphere or reflection from raindrops. This would yield information on the quantities of water present in the atmosphere, for use in meteorological work.

Various infra-red systems are possible and most of them fall between television and radar in their overall attainments as image-producing systems. Infra-red scanning has in addition some application in meteorological survey for heat balance work and water vapour radiation studies, as well as military applications.

Of the interrogation systems mentioned, film scanning with telemetry is the most feasible system for use with photographic survey and would best be achieved using a flying spot scanning device. Using sophisticated electron optics and a scan of 1,000 lines, quite useful resolutions could be obtained, suitable for some military as well as meteorological and other uses.

The recovery of actual film, while giving the highest possible resolutions available for scrutiny from a satellite reconnaissance system, is a much more ambitious concept. Film would have to be selected (with the aid of the lower resolution telemetry process) and then separated from the main batch, packaged, and reclaimed from orbit. The scheme requires an elaborate recovery system involving aircraft or ships and facilitates for the interpretation of the information contained on the film.

A package would have to consist of a capsule, suitably protected by a re-entry body, an attitude sensor and stabilizer, a retro-rocket to decrease the package velocity after separation from the satellite and so initiate re-entry, a small locating transmitter and a parachute system. The entire system would require the successful operation of a large number of processes and these processes must be reliable, requiring considerable development. However, despite the difficulties associated with film recovery the results obtainable would be of such value as to justify a great deal of attention being paid to the development of the system.

The U.S.A.F. SAMOS satellites are being developed to the film recovery stage and a SAMOS satellite launched on Jan. 31, 1961, contains photographic as well as television equipment. This model, however, has only a telemetry interrogation system.

The telemetry process is a reliable means of transmission of information from a satellite to the ground, and, when used in conjunction with the television process, "live," i.e., real time, transmission or temporary storage of the acquired information on magnetic tape and later transmission are alternative features of the system. In the case of military reconnaissance transmission would normally be impracticable from the survey area.

The accompanying table lists the American meteorological and military reconnaissance satellites launched or planned.

Other Possibilities

Development of reconnaissance satellites and the associated data acquisition systems will find useful application in future long-term spaceflight programmes, for instance in the exploration of the Moon and other celestial bodies prior to the landing of the first manned vehicles on these bodies. Another interesting possibility is the use of the Moon itself as a reconnaissance satellite. Although the distance involved is great the Moon would be a very stable platform on which to mount elaborate equipment.

For some long-term applications there is considerable argument in favour of manned reconnaissance satellites. Manned observation of the Moon and other bodies would be a necessary preliminary to landing on them.

UNITED STATES MILITARY RECONNAISSANCE AND WEATHER SATELLITES

Satellite	Launch vehicle	Orbit	Instrumentation	Remarks
SAMOS ..	ATLAS-AGENA-A	Polar Circle	Photographic and TV equipment.	Military recce. vehicle. One launched, others to follow.
TIROS I ..	THOR-ABLE	48° inclined	Two TV cameras.	Weather satellite. In orbit.
TIROS II ..	THOR-DELTA	50° inclined	TV cameras, infra-red scanners.	Weather satellite. In orbit.
TIROS III..	THOR-DELTA	50° inclined	TV cameras, infra-red scanners.	Weather satellite, not yet launched.
NIMBUS I	THOR-AGENA-B	Polar	TV cameras, infra-red equipment, solar radiation equipment.	Advanced weather satellite. Not yet launched.
NIMBUS II	THOR-AGENA-B	Polar	TV, infra-red solar spectrometer and radar equipment.	Advanced weather satellite. Not yet launched.
AEROS I ..	CENTAUR or SATURN	Synchronous	TV, infra-red, solar spectrometer and radar equipment.	To follow the Nimbus programme.

Mercury Triumphs

Cdr. Shepard walks to the launching pad carrying a portable air conditioner connected to his pressure suit.

EVERYONE in the free world must be delighted that the Americans have proved their ability to send a manned ballistic vehicle into space under full control and bring it down safely. The sub-orbital test took Cdr. Alan Shepard to a height of 115 miles and 302 miles downrange—extremely close to the predicted values—in the Mercury capsule.

The capsule itself weighs little more than 2,300 lb., which compares with 10,418 lb. of the Russian Vostok. Designing and building a spacecraft of such small mass, and providing it with so many control and safety features, is no mean technical achievement and the greatest credit is due to NASA and its industrial contractors, headed by McDonnel Aircraft Corporation.

The Americans have, as a necessary step, to demonstrate the working of the capsule under the more severe conditions of re-entry following orbital flight; then the speed will be 17,500 m.p.h. instead of the 5,100 m.p.h. achieved with Redstone. This more rigorous test will involve the Atlas booster, but a true orbital mission cannot be expected before a dummy astronaut and perhaps a chimpanzee have circled the World and been recovered. As we reported last week, the first attempt to orbit a "breathing, sweating and talking" robot failed on Apr. 25 when the Atlas refused to work according to programme after lift-off.

Cdr. Shepard's successful mission followed an earlier launching attempt on May 2 which had to be called off because of squally weather encompassing Cape Canaveral and the planned recovery area some 290 miles downrange. After the postponement, the Redstone had to be drained of its liquid oxygen, dried, and made ready for another fuelling, a procedure which takes up to 48 hours.

On the morning of May 5, all was again ready for the Redstone to be launched at 07.00 hrs. local time (13.00 hrs. B.S.T.). But delays occasioned by worsening weather and a faulty inverter in the rocket brought about a delay of some 2½ hours, during which time the servicing gantry was moved back over the pad and the inverter replaced. The hatch of the capsule had been sealed at 06.10 local time (12.10 B.S.T.); Cdr. Shepard remained within all this long time.

Meanwhile, the countdown was continued and lift-off eventually occurred 13 seconds after 09.34 hrs. (15.34 B.S.T.). Thanks to the excellence of the radio and TV coverage of this historic event, details of the flight itself will be known to most people. The Redstone booster performed reliably, reaching a cut-off velocity of some 5,100 m.p.h., and the capsule performed the mission almost to the last detail as had previously been outlined by NASA. Total flight time was about 15½ minutes, and during the period of weightlessness which ensued at the peak of the trajectory, Cdr. Shepard got the feel of manual orientation of the capsule by working the reaction controls in roll, pitch and yaw. After the capsule had been restored to automatic stabilization, he also fired the retro-rockets. (It may be noted in this connection that Major Gagarin's spacecraft embodied similar facilities for manual operation.)

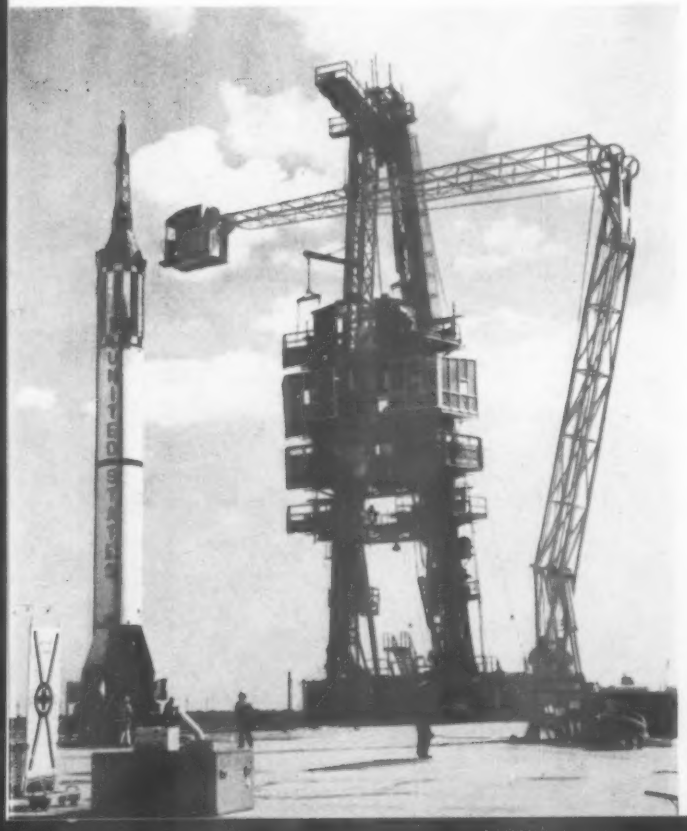
Inside the Capsule

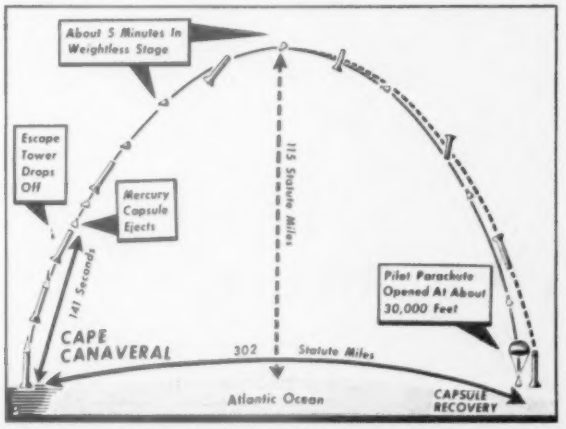
As we reported last week, the capsule contains 127 lights, fuses, switches, controls and indicators. These are mounted on a three-bank instrument panel. Between the centre panels, and about two feet from the astronaut's face, is the periscope display which provides a view of the Earth 1,900 miles in diameter on low magnification; on high magnification, it gives a clearer view about 80 miles across. A description of this device, with a diagram showing how the astronaut can also find the attitude of the capsule by means of indices on the viewing screen, was published in our issue of Oct. 28, 1960, p. 591. The Vostok carried similar devices for attitude determination, giving the occupant the ability to position his spacecraft by manual control for firing the retro-rockets to initiate re-entry under emergency conditions.

Two-way radio communication is maintainable between the Mercury astronaut and ground stations throughout the mission.

The astronaut's couch is made of crushable honeycomb material to support the occupant against high accelerative forces, including "hard" landings. Each of the seven Mercury astronauts has his own couch, moulded to his personal contours. The restraint system consists of shoulder, chest, leg and crutch straps, a lap belt, and special toe guards to hold the astronaut firmly in the couch against braking forces.

The environmental control system provides the astronaut





The 29-ton Redstone booster, with Mercury capsule mounted, stands ready on Pad 5 at Cape Canaveral. Behind is the servicing gantry and, at right, the "cherry picker" hoist.

Clad in his 20 lb. pressure suit, Cdr. Alan B. Shepard is helped into the Mercury capsule to await the moment of lift-off — some 3½ hours later.

with oxygen, pressurization, ventilation, and a comfortable temperature. It works automatically but, if necessary, the pilot can operate it himself.

Throughout the flight, reports are telemetered to ground stations concerning the astronaut's breathing, heart action, and body temperature. (Shepard endured decelerations of up to 11 *g*.)

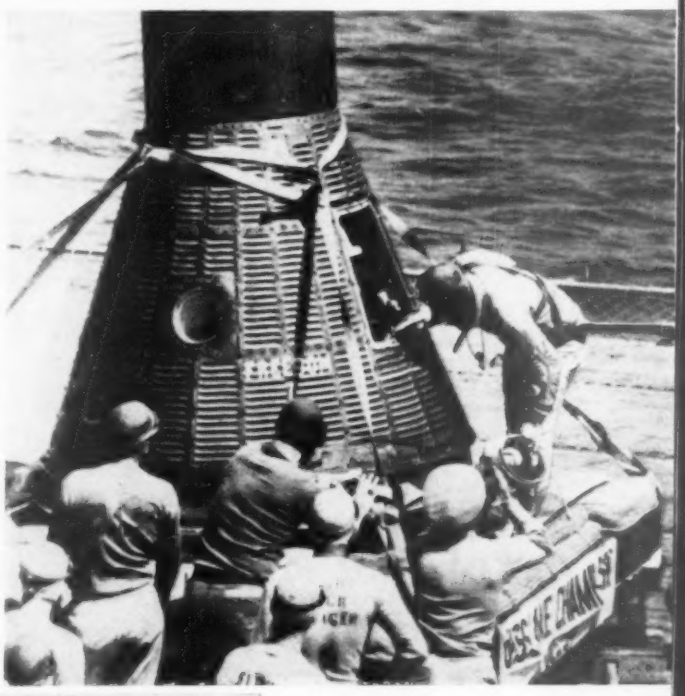
Cameras preserve a record of the instrument panel indicators and of the pilot's actions. A timing device tells him when various operations are set to begin and how long he has been aloft. An altimeter dial indicates when the parachutes are about to deploy.

An interesting sidelight on the operation is that part of the astronaut's personal survival equipment is a SARAH (Search and Rescue Homing Beacon) of the type which the British company of Ultra Electronics, Ltd., have developed for providing accurate location of ditched aircrew. There is another SARAH beacon in the capsule itself which contains two items, both designed by Ultra Electronics (one manufactured in London and the other partially there); this ensures both highly accurate and long-distance location of the capsule under the most adverse conditions.

Each one of the 100 aircraft engaged in the search operation for the capsule following its re-entry and landing is equipped with an Ultra-designed SARAH receiver. Fifty of these sets were also made by Ultra Electronics, Ltd. Distribution and adaptation of the Ultra equipment in America have been carried out by Simmonds Precision Products, Inc., in New York. The same homing equipment had previously played its part in locating the chimpanzee Ham and the monkeys, Able and Baker, which were the subjects of earlier space experiments.

The Mercury capsule in which Cdr. Shepard travelled had enough air, food and water to sustain the astronaut for at least 28 hours. There was also a survival kit containing everything from a reserve parachute and life-raft, to shark repellent, first-aid kit, signal mirror, rations, matches and a whistle.

NASA expects to make another manned sub-orbital launching over a similar distance in the last week of June, this to be followed by a third attempt some six weeks later. This will give the two other astronauts shortlisted for the first Redstone shot, John Glenn and Virgil Grissom, a chance to gain experience of spaceflight so that, when the time comes for the full orbital mission, a final selection can be made from among the three. The remaining four astronauts under training in the United States will be given their chance later.



Above, Cdr. Shepard looks into the capsule after he had been taken on board the aircraft carrier U.S.S. "Lake Champlain." The exit hatch had fallen into the sea when he emerged.

Left, The astronaut is hoisted into the Sikorski HUS-1 helicopter at the conclusion of his historic mission.

Flying a Brace of Dorniers

By John Fricker

The close relationship between the Dornier Do 27 and the twin-engined Do 28 is evident from this formation photograph at Baginton.

TWO of the most interesting visitors to the recent Shackleton sales week-end at Baginton were the Dornier twins—or more accurately, the twin-engined Do 28 and the parent single-engined Do 27. Both are unusual in combining executive comfort and cruise performance with STOL capability, and the Do 28, in particular, proves the success of a new design formula giving unique qualities among aircraft of its size and class.

About 90% of the airframes of the two aircraft are common to each, and the normal accommodation for two crew and four passengers in the rear cabin is also identical. The unusually fine view, for high-wing aircraft, is shared between the Do 27 and Do 28, which seat their pilots forward of the mainplanes behind centre-hinged curved transparent doors with sills below seat level. Cockpit layout in each case remains similar, apart from the greater number of instruments and double set of power levers on the central quadrant of the Do 28, and its substitution of handwheels on straight columns for the dual sticks of the Do 27.

Both have a big central lever with a twist-grip top for manual operation of the double-slotted flaps which, with drooping inner portions of the similarly lift-augmented ailerons plus full-span fixed leading-edge slats, confer the remarkable slow-speed performance. They also share an enormous and convenient handwheel between the front seats for varying tailplane incidence to cope with the usual trim changes attendant on high-lift aeroplanes.

Passengers in the Dorniers are seated in a sort of solarium, the large window of which on each side is also an entrance door, while the roof is also an open area of transparency, giving an unrivalled all-round view. This is a legacy of the military origins of the Do 27, which started life as an observation and liaison type for the German forces, 428 having been ordered. Most of these have now been delivered, and about 100 other Do 27s have been ordered for civil and other military contracts, including the Belgian, South African and Swiss forces.

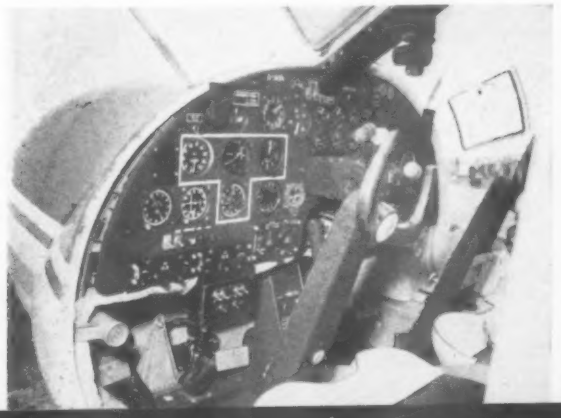
Versions of the Do 27 include the A, A-4, B, H-2, Q-1, Q-3, Q-4, Q-5, Q-6 and S(Seaplane), powered by various engines ranging from the 230-b.h.p. Continental O-470-K to the 340-b.h.p. Lycoming GSO-480-B1B6, plus the experimental Do 27T, powered by the Astazou turboprop. Current production models have bowed instead of straight mainwheel legs to widen the undercarriage track for better ground stability.

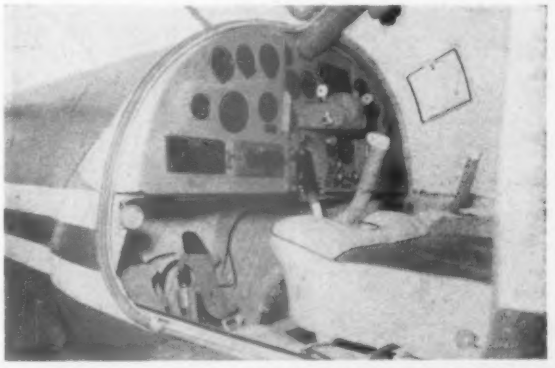
The Do 28 was developed by adding a stub wing to a standard Do 27 airframe, carrying two 180-b.h.p. Lycoming O-360 engines at its extremities, together with fixed mainwheel legs, and fairing in the nose of the fuselage in place of the original powerplant. Technically, the Do 28 can be considered a biplane, or at least an abbreviated sesquiplane; the 58 sq. ft. stub wing probably just about earns its keep in contributing lift. It provides a clever and convenient location to hang the close-set engines, which in the second prototype and production aircraft, are 250-b.h.p. Lycoming O-540s.

Production Do 28As, including the visiting A-1 for Deutsche Nahluft Verkehr, have a 6-ft. extension in span, through an addition of wing-root bays to the original mainplanes of the Do 27. These provide extra stowage for fuel, which in the Do 28 comprises two main tanks totalling 70.3 Imp. gal., plus two auxiliary tanks with 30.6 Imp. gal., or 101 Imp. gal in all. The Do 27 normally carries 48.4 Imp. gal in its wing tanks, which may be supplemented by auxiliary containers to bring the total capacity to 80 Imp. gal.

Except for their control surfaces and flaps, which are fabric-covered, the Dorniers are of all-metal stressed-skin construction of a particularly robust nature. Both were built to conform to U.S. CAR Part 3 standards, with the high ultimate load factors of 5.7 *g* (Do 27) and 5.5 *g*. These figures are especially creditable in view of the very large structural cut-outs in the semi-monocoque fuselage for entry doors and windows. An additional hatch is provided aft of the cabin in each case for baggage stowage in an 8.8-cu.-ft. compartment.

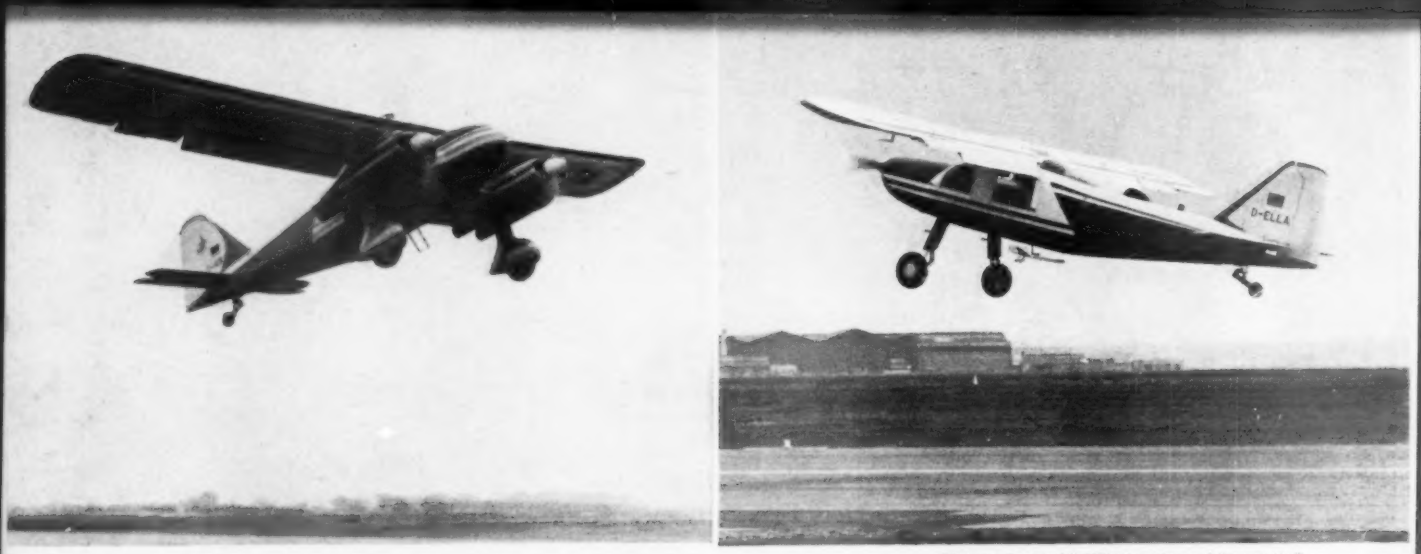
Prior knowledge of its high load factors would have been very comforting during my initial trip in the visiting Do 27Q-4, D-ELLA. Having scaled the lofty undercarriage leg—with its





Photographs copyright "The Aeroplane and Astronautics"

Duplicated power controls, additional instruments and handwheels instead of sticks distinguish the cockpit of the Do 28 (left) from that of the Do 27. Among other differences, the Do 28 has U.S. key-type ignition switches instead of the German vertical lever.



Photographs copyright "The Aeroplane and Astronautics"

In characteristic attitudes, with double-slotted flaps and aileron sections extended, the Dornier Do 28A-1 and Do 27Q-4 demonstrate STOL techniques at Coventry. Both can fly at less than 30 knots I.A.S.

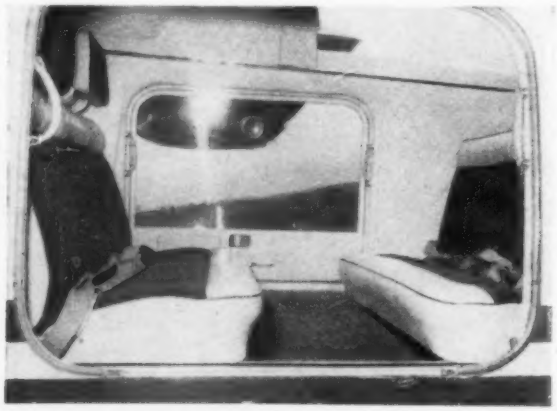
oversize tyre for soft-field operation—for access to the cockpit on the starboard side, I watched Herr Scheidt of the Dornier company coax the 270-b.h.p. Lycoming GO-480-B1-A6 engine into deep-throated life, and taxi out of Baginton's congested parking area with a stab or two of toe brake.

With tailplane trimmed neutral, Herr Scheidt opened up to full power of 0.9 Ata and 3,500 r.p.m., and pushed the stick forward almost to the dashboard. As the Do 27 accelerated to about 50 knots, he dumped the full 45° of flap with the central lever, which gave a similar effect to pulling up the collective pitch control of a helicopter.

The Do 27 leapt into the air and, as the nose was pulled steeply up to an A.S.I. reading of 30 knots, accompanied by a little buffet from flap flow over the tailplane, rudder was applied to start a steep spiral. The V.S.I. indicated 1,300 ft./min. before flap was raised and power reduced to max. continuous of 0.9 Ata and 3,000 r.p.m.

Speed was then allowed to build up to normal climb setting of 70 knots, before a further reduction in power setting rapidly followed for a brief cruise at 110-115 knots. From there, the Do 27 was pulled up vertically into a majestic stall turn, and the 140 knots recovery from the ensuing dive was used to make an impeccable upward roll into cloud over Baginton airfield. This is not the sort of handling one expects to be possible from a high-lift aeroplane, but, to show that there was no deception, Herr Scheidt repeated the upward roll after we had emerged from cloud.

He then applied full flap and power, after a vigorous aft wind of the tailplane trim wheel, and pulled the stick back until the A.S.I. went off the clock at below 30 knots. Lateral control was still available to keep the wings level; and when he suddenly cut the power in this rather exaggerated attitude, the nose dropped steeply but quite straight during stall recovery. He completed his interesting demonstration by switching off the engine completely over the middle of the airfield at 1,000 ft., pulling the Do 27 up on its tail until the prop. stopped, and then fluttering down through the busy circuit in a sort of succession of falling-leaf type manœuvres until touching-down smoothly dead-stick on the runway.



The Dorniers offer their four rear passengers a superb all-round view and considerable comfort. The Do 28 can accommodate up to six in this cabin, or 1,100 lb. of freight, if required.

My own exploration of Do 27 handling was a little less abandoned, although I was led through the helicopter-type take-off and initial 30-knot climb. Apart from this sort of manœuvre, the Do 27 flies conventionally enough, with moderate and well-harmonized control forces, and out-of-trim loads less than I had anticipated from a high-lift aeroplane.

For comfort, however, I was shown the advisability of winding back full tailplane trim before attempting to lower flap. Although the flap limit speed is about 70 knots, it is difficult to lower the full 45° against the air loads unless speed is reduced to a much lower figure.

With a little power, some sort of stall can be achieved by hard aft stick pressure at about 35 knots, but the Do 27 never really quits flying under these conditions. At 50 knots, with flap and power, the ailerons are light and effective for very tight turns, in which the inner wing tip appears to move backwards over the ground, with lots of bank held off to prevent over-tightening. At 0.48 Ata and 2,700 r.p.m., with flap, it was possible to cruise hands off in a fairly flat attitude at a mere 40 knots, with a superb view and in great comfort.

Before trying to land the Dornier, I tried a simulated overshoot from the landing configuration, but the Do 27 showed less of a nose-up tendency as power was added than many comparable designs. Power off, on finals, it was possible to make a near-helicopter approach at a fearsome angle, maintaining 60 knots by pointing apparently vertically towards the ground, and holding this attitude for a low and brief flare-out when it became possible to distinguish individual blades of grass. Elevator response remained effective, even at our forward C.G. position, for a controlled touchdown at a brisk walking-pace.

Transferring to the Do 28, I found cockpit access reasonably simple via the cabin steps, fuselage hand-holds and the stub wings. The closely cowled Lycomings, with their twin exhaust ejector tubes, intrude less than I had imagined on downward view, and all-round visibility is well above average for a light twin. In the three-point attitude, the snub nose of the Do 28 restricts vision immediately forward, but a gentle weave with the aid of toe brakes and the castoring tailwheel (optionally steerable), plus differential engine if required, clears the way.

Engine starting is by ignition key actuation, and the noise level seems less than in the Do 27 cockpit. The central flap lever has the same 0-15-35-45° stops on its quadrant, but a small rudder trim wheel appears in the Do 28, alongside the classic wooden tailplane trimmer. The spatted mainwheels of the wide-track undercarriage are well sprung for a soft ride on rough grass.

Take-off technique is similar to that employed with the Do 27, i.e., control wheel right forward on opening up to full power of 0.95 Ata and 2,575 r.p.m., centering the column as 45° of flap is dumped at about 40 knots. Coarse rudder movement was initially required to keep straight, although directional control is adequate for the very low unstick speeds. Safety speed of the Do 28 at full power is only 45 knots, and we were taking off at 50 knots using the STOL technique, before climbing away with a blip or two of the stall-warning horn at the lower figure.

Ground run of the Do 28 at max. weight of 5,400 lb. is only a couple of hundred yards, and initial climb at max. continuous power is 1,300 ft./min. On one engine, this reduces to 300 ft./min. at sea level, and 100 ft./min. at 5,000 ft.

A peculiarity of one's initial impressions of handling the Do 28 is that the lateral control is decidedly lighter than in the Do 27, which is unaccountable in view of the higher aspect ratio wing, greater inertia of the twin Lycomings and greater weight. I established that this was not due to servos, and Bernd

Koffmane, the demonstrating pilot, suggested that this impression might be due to the Do 28 having a control wheel instead of a stick.

At the 74% power setting of 2,350 r.p.m. at 6,500 ft., the Do 28 will cruise at 142 knots, using 25 Imp. gal./hr. During my two flights in D-IATA at Coventry, we never seemed to settle down to the cruise, and spent most of our time exploring the extraordinary low-speed handling of the Do 28. Once again, the drill before lowering flap was to haul the low-geared tailplane wheel fully back, and then raise the nose high to permit full aft movement of the manual lever. This could well be replaced by a more convenient system, such as a simple hydraulic hand pump, as in the Beaver and similar STOL designs.

With full flap and power off, the control wheel of the Do 28 can be held hard back on its stop, and the aircraft sinks steadily at a stabilized 45 knots. Control is then ample to make nose-high turns in each direction, with generous use of rudder to counter aileron drag, and vigorous application of then-sloppy aileron to compensate for the reduced lateral stability. Compared with the straight wing of the Do 27, the Dornier twin has been given some dihedral, and its fin and rudder area have also been increased, as one would expect.

By applying power, Herr Koffmane showed me that it is possible to make the Do 28 fly along at an alarming angle at airspeeds down to 25 knots, where a certain amount of airframe buffet is evident, but lateral control remains. The stall-warning horn begins to protest at that stage, but can be quietened by increasing speed to 30 knots, where turns can again be made. Clean, and power off, the Do 28 will nibble at the stall at 50 knots, but like its predecessor, it never really stops flying.

This docility remains in asymmetric flight, as I saw when Koffmane feathered the starboard Lycoming, and opened up the other to 0.88 Ata and 2,500 r.p.m. Foot loads were moderately high until cancelled by a twist of the rudder trim, when handling became unexceptionable. Rate four turns were made in each direction with no difficulty.

For a fairly conventional approach, 15° of flap were lowered at 85 knots, accompanied by a fair nose-down trim change if the tailplane wheel was not first rotated aft. Cutting power at 600 ft. on finals, and reducing speed to 65 knots facilitated lowering the rest of the flap, and at 55 knots thereafter, the Do 28 descended quite gently at about 600 ft./min. More aft trim can be used to help the flare-out from the steep approach attitude, although Herr Koffmane prefers to use power to check the sink after rotating to the three-point attitude, and comes in on the stall-warning horn at around 45 knots, to touch-down tailwheel first at 5 knots less airspeed. Ground run in either case is negligible.

Some finesse is required for STOL technique, but the Do 28 responds quite well to more conventional handling. It is rather more tractable, in fact, than such aircraft as the Rapide, for which it is a replacement, offering both improved short-field and cruising performance for a realistic U.K. price, delivered and duty paid, of £21,785. Twelve Do 28s have so far been built, including several for V.I.P. transport in the German forces, and their suitability for executive and charter flying should result in a rapid sale of the 36 due for completion this year.

Technical Data—Do 27Q-5 (Do 28 in parentheses)

DIMENSIONS.—Span, 39.4 ft. (45.3 ft.); length, 31.5 ft. (30.1 ft.); height, 8.9 ft. (9.2 ft.); wing area, 209 sq. ft. (241 sq. ft.).

WEIGHTS.—Empty, equipped, 2,490 lb. (3,680 lb.); useful load, 1,590 lb. (1,720 lb); max. gross, 4,080 lb. (5,400 lb).

PERFORMANCE.—Cruising speed, 60% power at 6,000 ft., 130 m.p.h. (150 m.p.h.); max. speed, S.L., 152 m.p.h. (174 m.p.h.); initial climb, 670 ft./min. (1,300 ft./min.); single-engine climb (300 ft./min.); service ceiling, 13,000 ft. (19,400 ft.); single-engine ceiling (6,500 ft.); stalling speed with power and flap, 31 m.p.h.; safe minimum flight speed (43 m.p.h.); take-off distance to 50 ft., zero wind, 935 ft. (1,000 ft.); landing distance, from 50 ft., zero wind, 590 ft. (700 ft.); absolute range, zero wind, 60% power at 6,000 ft., 995 st. miles (745 st. m.).

Personal Flying

ONE of the lesser-known facts about the recent Shackleton sales week-end at Baginton, Coventry, was that a record number of aircraft movements were recorded for a U.K. airfield. The total for the Friday, Saturday and Sunday amounted to 2,088, with a peak of 956 during the middle day. This compares with 400-420 movements on a Saturday during the summer season at London Airport.

In discussing the recommendations resulting from the week-end display, Frank Dismore, managing director of W. S. Shackleton (Aviation), Ltd., said that bearing in mind the extremely bad visibility throughout the period of the meeting, which prevented the company's own chief pilot flying from Elstree to Baginton on either the Saturday or the Sunday, it was a fair reflection of the enthusiasm for private and executive flying that so many movements were recorded. At one period, shortly after one of the flying displays, 142 aircraft took off in 90 minutes, and during the same period many of them landed again after completing local demonstration flights.

Aircraft waiting to take off were so numerous that the usual air traffic control system was dropped and control of both radio and non-radio aircraft was handled by Shackleton ground marshals in conjunction with an ATC officer at the take-off point on the runway. Air traffic personnel in the tower maintained a watching brief on the RT, giving help when needed.

No indication has been given as to the location of the 1962 Shackleton show, but it is to be hoped that it will be at a more convenient airfield from the demonstration point of view. What is wanted is an aerodrome clear of all control zones, with wider access to take-off and landing areas, and a runway available for the larger aircraft. Somewhere like Luton would seem to be suitable, if the other requirements of the sales week-end can be met.

For the 1962 programme, Shackletons propose to separate the new and used aircraft, and concentrate the layout in about half the size of this year's area. This will save a good deal of walking, and exhibitors will also be allowed a car on the airfield. There will be only one set flying display programme, on the Saturday of the meeting, so that more time will be available for demonstration flights. Friday will be a Private Guest Day, with entry by invitation only except for visitors arriving by air.

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Aircraft engineers and mechanics of the recently formed Air Services Division of Pressed Steel Company have been very busy servicing the five Piper Apaches which were ferried across the Atlantic towards the end of April for the College of Air Training, Hamble, and preparing them for the British validation of their U.S. Cs. of A. This is a typical operation for the Division, which is based at Kidlington, and is among the largest units of its kind in the U.K.

One of its functions is to provide complete after-sales service for aircraft manufactured by the Beagle group, and it is also geared to have a full maintenance service for light aircraft manufactured by other companies. Pressed Steel's Air Services Division is the only U.K. factory-authorized Piper service station.

Air Services Division general manager and chief pilot is Capt. J. W. Gillespie, and tech. manager is Mr. J. P. O'Hara.

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McAlpine Aviation, the business flying division of Sir Robert McAlpine and Sons, Ltd., has taken delivery of its second Helio Courier STOL executive aircraft. The first H-395 Courier, G-ARLD, was bought in time for its public debut at Baginton, where it was demonstrated by Capt. "Topsy" Turner, before entering service carrying McAlpine executives.

The two new American aircraft have been added to the McAlpine fleet to help rapid communication between construction sites, and they will also be used as demonstrators, since the Aviation Division has been appointed sole U.K. distributors for Helio. G-ARLD was the 152nd Courier so far built, and was accompanied to the U.K. by Dr. Lynn Bollinger of the Helio Corporation, who attended the Baginton display.

The Courier has the best speed range of any fixed-wing aircraft, with a minimum flight velocity, under full control, of 30 m.p.h., and a cruising performance of 170 m.p.h. It can carry five occupants, and the aerodynamics of the current production aircraft have been improved by replacing the former exhaust augmentation system by a conventional arrangement similar to that of the Beech Bonanza. With a closely cowled 295 b.h.p. Lycoming GO-480 engine and a three-bladed propeller, the Super Courier is about 15 m.p.h. faster than earlier models of this V-STOL type, which can take-off and land in a distance of 105 ft.

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● Norfolk and Norwich Aero Club is holding an open day at Swanton Morley on Jne. 25, with parachuting, crazy flying and other events. The club has a first-class bar in the club-house, where meals may also be obtained. Visiting aircraft are asked to arrive between 09.00 and 13.00 hr., and there will be a time-of-arrival competition.

● In its April newsletter the Surrey and Kent Flying Club draws attention to the new Southend Zone, which came into effect on Mar. 27 and extends over a radius of 8 n.m. from ground level to 6,500 ft. During March, first solos were achieved by Messrs. E. McNally, T. D. Newman, E. D. McEwen-Read and T. W. Stanhope.

A Tropical Farnborough

SINGAPORE'S recent international air show—its first—was generally accepted to have been a big success. Earl Jellicoe, the British Government representative at the show, summed it up thus: "It has been an admirable performance on the part of everyone in making this tropical Farnborough a success."

At the beginning of the show—which was held at Paya Lebar airport—Mr. K. M. Barclay, Singapore's Director of Civil Aviation, said that in staging it the Singapore Government had provided a most suitable occasion to commemorate the opening of the airport's new operations building.

The opportunity to take part in the show by the display of their services and manufactured goods had been taken by a large number of the exhibitors whose main places of business were widely spaced throughout the World. In this action could be seen the significance with which Singapore's leading place in South-east Asia's aviation and commerce was viewed.

Confidence held by the Singapore Government in the future of aviation was expressed by its declared determination to erect new buildings, to provide new radio and radar equipment and to keep abreast with all necessary developments at the airport. This confidence was most encouraging for all concerned in the aviation industry.

Mr. Barclay concluded by saying that special mention must be made of the valuable contribution by the United Kingdom Commissioner and his staff and the officers and men of the Royal Navy, the Royal Air Force, the Royal Australian Navy, the Royal Australian Air Force and the Royal New Zealand Air Force.

The new operations building to which Mr. Barclay referred cost (Malayan) $2,000,000 and was declared open on the first day of the air show by Inche Yusof bin Ishak, Singapore's Head of State.

Official figures are not to hand but it has been variously estimated that between 250,000 to 400,000 people saw the show. Revenue was about $60,000, and as a result of this the event was run at little or no cost to the Singapore Government. About 7,000 people were involved in preparing the exhibition, held on a seven-acre section of Paya Lebar airport. There were 106 stands, most of them for aviation purposes.

The Australian pavilion proved a great attraction. Among the displays in it were Skylark, Long Tom and Ham rockets which, it was claimed, could have been fuelled and fired from the show site. Also on view at this pavilion were rocket heads that had been shot into space at Woomera range and recovered.

A Skylark nose-cone—partly flattened and still caked with mud—which had gone into space and had parachuted back to Earth was closely examined by a large portion of the cluttering thousands at the airport. NASA displayed a model of the Tiros 1 weather satellite launched from Cape Canaveral. A backdrop panel contained a mosaic of some of the 23,000 photographs transmitted from this satellite in the immediate period after the launching, a detailed explanation of the instrumentation of Tiros 1, and maps showing an orbit pattern.

Models of the Avro 748 and the de Havilland Dove 8 were among the many attractions at the large display of the Jardine Waugh organization, which represents the Hawker Siddeley Aviation Group and other leading concerns. This exhibit also included models of the de Havilland Comet and Sea Vixen, the Armstrong Whitworth Argosy, Folland Gnat, Gloster Javelin and Hawker Hunter. Single and Twin Pioneers of Scottish Aviation were well publicized at the display, which contained also a cut-away Rolls-Royce Dart RDA7.

Jardine Waugh also represents Westland, Auster, Alvis, and Hong Kong Aircraft Engineering Co. In another section of the show, Bristol Siddeley Engines had a stand which included a cut-away Orpheus 803 turbojet engine.

Nihon Aeroplane Manufacturing Co., a joint venture of the Japanese Government and Japanese private corporations, had on view at its stand a model of the YS-11 turboprop (Rolls-Royce engines) airliner. Fokker had an exhibit and was boosting the F.27 Friendship.

Pye Telecommunications had among its equipment on view a model of an instrument landing system, an industrial television installation, and transmitters and receivers. Philips Telecommunications Industries had a large exhibit which contained radar and telegraphy switching gear, and closed-circuit television. Standard Telephones and Cables Pty. had among the products on display a variety of air and sea navigation aids.

A model radar head was shown by Marconi's Wireless Telegraph Co., also a sub-miniature automatic direction finder, in addition to other equipment. International Aeradio (Far East) showed a wide range of products of organizations which it represents—including Decca Radar.

Airlines were at the event in force. Among those vying to impress the public with attractive displays were Garuda Indonesian Airways, B.O.A.C., Cathay Pacific Airways, Pan American Airways, K.L.M. Royal Dutch Airlines, Air Ceylon, Air-India International, Qantas, Malayan Airways, Japan Air Lines, and Thai Airways International.

Also exhibiting were: Shell, Dunlop, the New Zealand Government, the Australian National Tourist Association, Handley Page, Graviner and Standard-Vacuum Oil.

There were static exhibits of all sorts of civil and military aircraft, but the crowds had a greater thrill from the flying displays on three days by planes of the Royal Navy, Royal Air Force, Royal Australian Navy, Royal Australian Air Force and Royal New Zealand Air Force. In addition to the Canberras, Meteors, Sabres, Scimitars, Sea Vixens, Venoms, Gannets and Whirlwinds, a Javelin flashed to and fro across the sky: it was a surprise item and had been, it was said, specially flown out from Farnborough. It so happened that it appeared on the day when the show had its best attendance—anything up to 100,000 people, according to reports which cannot be confirmed at the moment.

This event, with its great benefits in various ways, well deserved its success and was presumably the forerunner of many more Singapore international air shows. A. R. COLE.

Aviation industry was well represented at Singapore's recent air show. Philips Telecommunications (below left), had a large stand and many British companies, including Scottish Aviation and Rolls-Royce (below), were represented by the Jardine Waugh organization.

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The opportunity to take part in the show by the display of their services and manufactured goods had been taken by a large number of the exhibitors whose main places of business were widely spaced throughout the World. In this action could be seen the significance with which Singapore's leading place in South-east Asia's aviation and commerce was viewed.

Confidence held by the Singapore Government in the future of aviation was expressed by its declared determination to erect new buildings, to provide new radio and radar equipment and to keep abreast with all necessary developments at the airport. This confidence was most encouraging for all concerned in the aviation industry.

Mr. Barclay concluded by saying that special mention must be made of the valuable contribution by the United Kingdom Commissioner and his staff and the officers and men of the Royal Navy, the Royal Air Force, the Royal Australian Navy, the Royal Australian Air Force and the Royal New Zealand Air Force.

The new operations building to which Mr. Barclay referred cost (Malayan) $2,000,000 and was declared open on the first day of the air show by Inche Yusof bin Ishak, Singapore's Head of State.

Official figures are not to hand but it has been variously estimated that between 250,000 to 400,000 people saw the show. Revenue was about $60,000, and as a result of this the event was run at little or no cost to the Singapore Government. About 7,000 people were involved in preparing the exhibition, held on a seven-acre section of Paya Lebar airport. There were 106 stands, most of them for aviation purposes.

The Australian pavilion proved a great attraction. Among the displays in it were Skylark, Long Tom and Ham rockets which, it was claimed, could have been fuelled and fired from the show site. Also on view at this pavilion were rocket heads that had been shot into space at Woomera range and recovered.

A Skylark nose-cone—partly flattened and still caked with mud—which had gone into space and had parachuted back to Earth was closely examined by a large portion of the cluttering thousands at the airport. NASA displayed a model of the Tiros 1 weather satellite launched from Cape Canaveral. A backdrop panel contained a mosaic of some of the 23,000 photographs transmitted from this satellite in the immediate period after the launching, a detailed explanation of the instrumentation of Tiros 1, and maps showing an orbit pattern.

Models of the Avro 748 and the de Havilland Dove 8 were among the many attractions at the large display of the Jardine Waugh organization, which represents the Hawker Siddeley Aviation Group and other leading concerns. This exhibit also included models of the de Havilland Comet and Sea Vixen, the Armstrong Whitworth Argosy, Folland Gnat, Gloster Javelin and Hawker Hunter. Single and Twin Pioneers of Scottish Aviation were well publicized at the display, which contained also a cut-away Rolls-Royce Dart RDA7.

Jardine Waugh also represents Westland, Auster, Alvis, and Hong Kong Aircraft Engineering Co. In another section of the show, Bristol Siddeley Engines had a stand which included a cut-away Orpheus 803 turbojet engine.

Nihon Aeroplane Manufacturing Co., a joint venture of the Japanese Government and Japanese private corporations, had on view at its stand a model of the YS-11 turboprop (Rolls-Royce engines) airliner. Fokker had an exhibit and was boosting the F.27 Friendship.

Pye Telecommunications had among its equipment on view a model of an instrument landing system, an industrial television installation, and transmitters and receivers. Philips Telecommunications Industries had a large exhibit which contained radar and telegraphy switching gear, and closed-circuit television. Standard Telephones and Cables Pty. had among the products on display a variety of air and sea navigation aids.

A model radar head was shown by Marconi's Wireless Telegraph Co., also a sub-miniature automatic direction finder, in addition to other equipment. International Aeradio (Far East) showed a wide range of products of organizations which it represents—including Decca Radar.

Airlines were at the event in force. Among those vying to impress the public with attractive displays were Garuda Indonesian Airways, B.O.A.C., Cathay Pacific Airways, Pan American Airways, K.L.M. Royal Dutch Airlines, Air Ceylon, Air-India International, Qantas, Malayan Airways, Japan Air Lines, and Thai Airways International.

Also exhibiting were: Shell, Dunlop, the New Zealand Government, the Australian National Tourist Association, Handley Page, Graviner and Standard-Vacuum Oil.

There were static exhibits of all sorts of civil and military aircraft, but the crowds had a greater thrill from the flying displays on three days by planes of the Royal Navy, Royal Air Force, Royal Australian Navy, Royal Australian Air Force and Royal New Zealand Air Force. In addition to the Canberras, Meteors, Sabres, Scimitars, Sea Vixens, Venoms, Gannets and Whirlwinds, a Javelin flashed to and fro across the sky: it was a surprise item and had been, it was said, specially flown out from Farnborough. It so happened that it appeared on the day when the show had its best attendance—anything up to 100,000 people, according to reports which cannot be confirmed at the moment.

This event, with its great benefits in various ways, well deserved its success and was presumably the forerunner of many more Singapore international air shows. A. R. COLE.

Aviation industry was well represented at Singapore's recent air show. Philips Telecommunications (below left), had a large stand and many British companies, including Scottish Aviation and Rolls-Royce (below), were represented by the Jardine Waugh organization.

and striking proof of FR versatility

The Avro Vulcan bomber with its Blue Steel missile is a formidable combination. FR equipment is fitted in both. High test peroxide and kerosene equipment for the Blue Steel; pressure refuelling valves, float switches, refuelling nozzles and refuelling indicators for the Vulcan, also specialised couplings for ground refuelling.
FR versatility also reveals itself in dependable fuel systems and components supplied for civil aircraft of every size and type — from personal and training aircraft and helicopters right up to the largest airliners.

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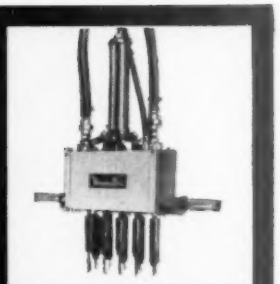
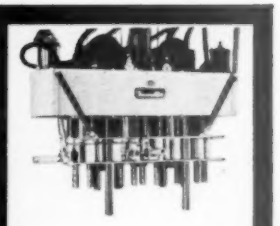
TA5017

CHOUF!



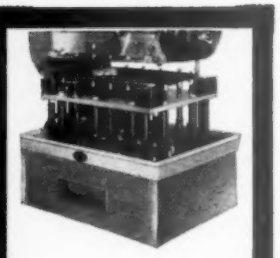
A Desoutter multi-studrunner plants 9 studs into an Austin cylinder block.

CHOUF!



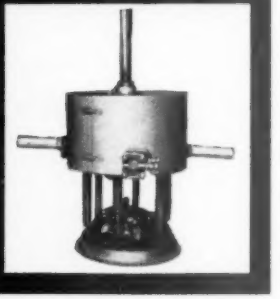
A Desoutter multi-nutrunner fixes 25 nuts on a Ford diesel cylinder head.

CHOUF!



A Triumph Herald sump is put on by a Desoutter 16-spindle multi-nutrunner.

CHOUF!



A Desoutter multi-nutrunner assembles a Vauxhall clutch plate, or tightens the wheel nuts on a Rootes Group car. And so it goes on. Nearly all mass-producing industries have a taste for that sort of music—and something to play it on! CHOUF! (on a carburettor)... CHOUF! (or a light fitting)... CHOUF! (or a washing machine)... CHOUF! (or anything else that needs assembling)

DESOUTTER MULTI NUTRUNNERS · SCREWDRIVERS AND STUDRUNNERS

DESOUTTER BROTHERS LIMITED · THE HYDE · HENDON N.W.9

C&C/DT/345

Correspondence

A.T.C. from all Aspects

YOUR report of the recent symposium on air traffic control appears under a misleading title! The respective responsibility of the State, the air traffic control officer, the civil airline operator and the military were covered in the lectures, as well as systems, equipment and aircraft, but a most significant aspect which was omitted was that of the pilot, the *raison d'etre* of A.T.C.

It is often forgotten that air traffic control exists solely to control aircraft. Therefore, the two people most closely associated with it are the controllers and those whom they control. Ironically, the latter's opinions are all too often ignored (sometimes even suppressed), and although the symposium gave an opportunity to those who plan and manufacture and to some of those who use these services, no pilot was invited to put forward his views in a paper. Thus the picture was incomplete and misleading.

I take this opportunity to repeat my appeal for a sense of urgency. Statements by officials on the length of time it takes to acquire and install equipment were not encouraging.

Mr. Anast's observations reassured those who have long supported the principle of a unified system and left them in no doubt that this must be the final solution to the problem of integrating civil and military aviation over the U.K. He convinced them that unified control must be implemented in the current programme if maximum air safety is to be achieved in the confined air space into which we must fit our many flying operations. Unfortunately his convictions and sense of urgency, which are based on extensive knowledge of developments in American A.T.C., are not so apparent among those responsible for this most important aspect of air safety in this country.

London, W.1. KENNETH G. BERGIN.
(Master, Guild of Air Pilots and Air Navigators)

Sunderland DP.198

MY attention has been drawn to an error in my letter on p. 443 (Apr. 20) in which I referred to Sunderland RN.303. This boat was scrapped several months before May, 1959, and, although I flew it on many occasions, I do not have its fog bell or control wheel.

The aircraft I intended to refer to was DP.198.

Chalfont St. Peter, Bucks. W. R. FOSTER.

Overcoming British Phlegm

AN Englishman, temporarily resident in Australia, I look forward to your magazine every week.

I have just digested the two dated Jan. 27 and Feb. 3, and have naturally been very interested in your editorial and articles on our efforts in Space.

Words fail me when commenting on Mr. Greenwood's article, he appears to have lost all his spirit and to have no conception of the cut-throat attitude of America towards British industry. Your editorial on the subject was first class and although I have not read *The Times* leader in question, I can well imagine its content. In a nutshell—complete lack of vision regarding the new age of Space.

I looked forward to Mr. Cleaver's article impatiently but was somewhat disappointed by the lack of force in his otherwise sensible remarks. He appears to have been blunted by criticism and upset by sneers regarding jingoism, etc.—this should be completely ignored. I am sure that he would agree that the British way of life is the only reasonable and moderate way.

The very people who condemn this thrust forward into Space, such as *The Times*, etc., are the very people who would scream the rooftops down at any change in our life. They fail to realize that it will be changed very forcibly if we become a "space puppet" and thence a scientific puppet.

To get down to fundamentals—the United Kingdom is *not* a poor country. Do not be misled by propaganda on that point. For instance the United Kingdom owns nearly as much in the United States as they do in Britain, our investments and resources are enormous. The point is that the Government do not want to spend the money on Space—they have no vision and the people have none either.

If we could only convince the people that we must re-create our old adventurous spirit (which should be the New Age of the Elizabethan seaman) we could explore the universe. Numbers of scientists do not impress—only one scientist in 1,000 has a really creative brain—and the United Kingdom always seems to have more than her fair share of these chaps.

For a start could we not lop one-ninth of the National Health Service off (£100 million or so). For the sake of a few false teeth and wigs, etc., we could get going!

To conclude—I don't think there can be any doubt about Britain's ability to explore our solar system and nearby systems, all that is lacking is the will—which the people of the U.S.S.R. have. The Americans have not got this will, they are merely competing with the Russians. The other Europeans (whom we can co-operate with by all means) would then want to join us on our terms instead of reluctantly joining on their terms. Surely, it is possible to fire the imagination of the British people with this great venture?

Sydney, N.S.W. D. J. ASHWORTH.

Groundabout

Question in the House. "Are we to understand that there will be no space flights by Great Britain because of the astronomical costs?"

*

The Same Name Game—1. Deciding on names for new-born infants is child's play compared with naming aircraft. More difficult still is choosing an aero-engine's name, so who can blame Bristol Siddeley for reviving "Pegasus" for their BS.53 lift-thrust engine? The old Bristol Pegasus radial powered the two Westland Houston - Mt. Everest biplanes of 1933 and Bristol's own Type 138A monoplane which in 1934 set a world altitude record of 53,937 ft. The new Pegasus provides the up-and-go power for the Hawker P.1127, for the operational development of which we might coin the name of, say, Hurricane?

*

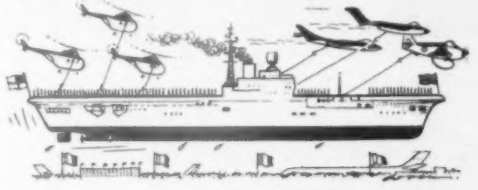
The Same Name Game—2. And while we're still round the font, how about naming the DH 125? Following the current traditional trend, "Dragon" seems a fair choice—alliterative, internationally pronounceable. The 1932 DH Dragon, according to Martin Sharp's "DH" book, was in service with Hillman Airways five months after the type's first flight. Those were the uncomplicated days. Well, *less* complicated.

*

Exit "Blue Arrows." The Press and all sorts of enthusiasts are trying to think up a name for 92 Sqn.'s aerobatic team. Their C.O., Sqn. Ldr. Brian Mercer, tells me the best name he can think of is "92 Sqn."

*

Vive le Refit. "The Hermes . . . has a summer programme to carry out before her refit. She will attend the Paris Air Show and then return to Portsmouth."—*Daily Express*, 27.4.61.



*

Newton Rides Again. "Shocking heavy landing of John's—first time I've seen anybody standing up on a stretcher."

*

The Muscle Barrier

"The Hatfield Manpowered Aircraft Club's original idea was to call themselves the Manpowered Aircraft Club of Hatfield but they decided the initials might be considered a bit ambitious."

by Gordon

Industry Record

Specialized Instrument Production

IN the middle of last year English Electric Aviation brought into commission a new factory for the development and production of specialized instruments. A self-contained unit within the company's guided weapons establishment at Stevenage, the factory now houses the division's Instrument Wing.

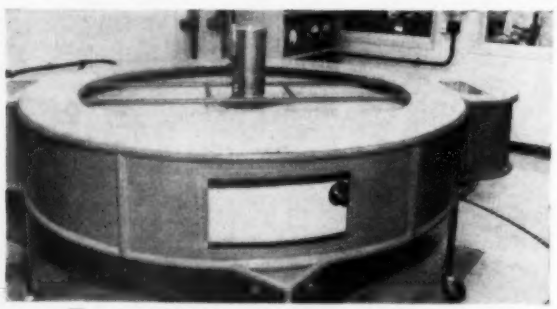
This section was first set up by English Electric as part of its plan to form comprehensive facilities for the manufacture of complete guided weapons systems. At first it produced relatively large displacement and rate gyroscopes for the Thunderbird ground-to-air missile. But with the later contract from the Army for the development of the Blue Water missile, a licence was taken out with Minneapolis-Honeywell in the United States for the manufacture and development of their 7-oz. miniature integrating gyroscope. Known as the MIG, this gyro has now been in production at Stevenage for two years.

The new factory consists of a single-storey building to help reduce vibration caused by high winds and is divided into three main areas. The first of these contain individual component manufacturing facilities; the second is employed for the assembly of these parts, and the third area is engaged in the testing and measurement of the final assemblies.

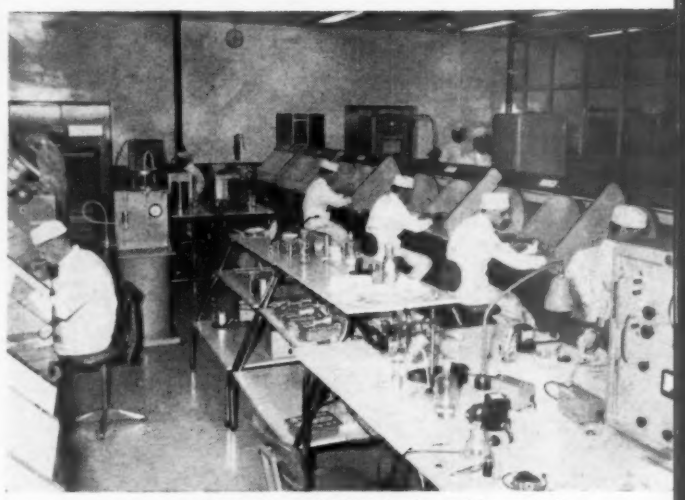
Dust is excluded from the assembly area or rooms by filtration of the air entering the building down to 0.1 microns. The temperatures of these rooms are maintained at 72° F. and humidity at between 35% and 45%. Partially pressurized assembly cabinets are also employed.

Because of the sensitive nature of the instruments, a number of special precautions have been taken to isolate them from all vibrations when under test. All moving machinery, including the air conditioning and cleaning plant for the wing, is 80 ft. away from the building and all connections for air filtration, temperature and humidity control are by flexible overhead ducts. Concrete plinths attached to 50-ton concrete blocks supported on inflated rubber bellows are used for testing and calibration.

A special centrifuge rotating on an air cushion above a slab of granite is employed for measuring the performance of accelerometers under known conditions of acceleration to an accuracy of a few parts in a million. In addition to its central, air lubricated bearing, the centrifuge has an instrument system which monitors the speed of rotation and change in radius of its arm.



The air-cushioned precision centrifuge at Stevenage.



Photographs copyright "The Aeroplane and Astronautics"

A general view of the super-clean assembly area.

All staff employed by the Instrument Wing—at present 400 and expected to build-up to 800 or more in the next two years—go through changing rooms to put on smocks and caps before entering the work area. Those engaged on final assembly in the super-clean area make a further change into overalls and anti-static boots.

Approximately 40% of the output from the Instrument Wing is for B.A.C.'s two major guided weapons—Blue Water and Thunderbird—in production at Stevenage. The remaining potential of the factory is being adapted to use the techniques employed in the manufacture of gyroscopes and other airborne guidance equipment for the development of instruments for other fields.

An example of this is the PIM system for the precision indication of the meridian. Developed for the War Office for the alignment of artillery and tactical guided weapons in the dark or bad weather, it employs a floating rate integrated gyroscope to detect north within one minute of arc by sensing the horizontal component of the Earth's rotation.

In addition to the development of advanced production techniques essential in the manufacture of high-performance instruments, it has also been necessary to design and develop a wide range of specialized production test equipment. One such item is the IFG 106 gyroscope test unit. This is capable of undertaking a full range of tests on a rate integrating gyroscope. It is now in production by the Instrument Wing and has been sold to users of MIG gyroscopes, and is being marketed for the users of rate integrating gyroscopes.

Licence for Dassault

British electro-mechanical equipment is to be produced in France by G.A.M. Dassault for its aircraft and guided missile programmes as the result of an agreement signed recently with the Woden Transformer Co., Ltd., of Bilston, Staffs. The British company produces this type of equipment for the Black Knight re-entry research vehicle and for Blue Steel, Avro's stand-off bomb.

Advanced Hydraulic Fluid

Following years of research by Imperial Chemical Industries in Britain and the General Electric Co. in the U.S., I.C.I. is to market a silicone hydraulic fluid for high-speed aircraft under the trade name Silcodyne H. It is also introducing an allied fluid, Silcodyne M, which is designed for use as an engine oil and lubricant at temperatures between +260° C. and −73° C.; this fluid consists of Silcodyne H with an oxidation inhibitor. Until now Silcodyne H has been known by its I.C.I. development number of DP 47.

The new fluid has been developed for use over a much wider range of temperatures than is possible with conventional hydraulic fluids. After considerable research this has been achieved by developing a silicone fluid which has the necessary properties without the use of additives. Silcodyne H has been tested at pressures of 4,000 p.s.i. and temperatures of +250° C. It has comparatively good lubrication qualities for a silicone fluid and low inflammability. It combines these features with other characteristics of conventional silicone fluids, which are a low rate of viscosity change with temperature and high thermal stability and resistance to shear breakdown. It is relatively inert and non-toxic.

Special design requirements apply to hydraulic systems which will use Silcodyne H. Its upper temperature limit should be regarded as 360° C. Copper should not be used in any parts of the system above 246° C. Aluminium and magnesium are attacked at high pressures and temperatures above 337° C. Most of the usual elastomers are not greatly affected by the fluid, but shrinkage occurs due to leaching of plasticizers. According to I.C.I., Viton can be used up to +260° C. and down to −40° C., but at the extremes of the temperature range the mechanical strength of elastomers is not good enough for dynamic

Industry Record . . .

seals. Dowty have developed a seal material which can be used with the fluid between −40° C. and +90° C.

The fluid has a low bulk modulus of about 150,000 p.s.i. at room temperature, which compares with 300,000 p.s.i. for most fluids. But it remains as high as 30,000 p.s.i. at +370° C. When designing systems for Silcodyne H, a big reservoir should be provided, the system should be pre-pressurized with nitrogen and components should be large enough to compensate for the low bulk modulus of the fluid.

The cost of Silcodyne fluids is high at present. Depending on the demand for them, the cost will fall, but I.C.I. expect that they will always be twice or three times as expensive as phosphate-based fluids because of the high capital cost of the plant needed to produce them.

No operational experience has yet been gained with aircraft hydraulic systems using Silcodyne fluid, but it is now being used in constant-speed drives.

Detailed information about Silcodyne H and M is available from the Silicones Department, I.C.I. Nobel Division, Stevenston, Ayrshire, Scotland.

Simulator with a Difference

In order to provide pilots with all the varying control and movement sensations experienced when flying high-speed aircraft in adverse weather conditions, the precision engineering division of Short Brothers and Harland, Ltd., has produced a moving-cockpit flight simulator. This has been built for the M.o.A. and is shortly to be delivered to the R.A.E., Bedford.

The simulator consists of a heavy steel structure surmounted by a wide movable arm to which an aircraft cockpit will be attached. The arm, powered by electro-hydraulic servos, can swing the cockpit up and down or tilt it from side to side, simulating pitch and roll. Normal flying controls in the cockpit will enable the pilot to govern its attitude.

In simulated still-air conditions the cockpit is completely under the pilot's control. So as to test his reactions in unfavourable flying conditions a special analogue computer feeds disturbances of any desired pattern into the control system, simulating gusts and turbulence. This causes the cockpit to move accordingly. It is the pilot's task to "fly" the simulator in these conditions.

In the roll plane the cockpit can tilt 15° from horizontal on each side at a maximum rate of 45° per sec. In pitch the limits are from 20° above horizontal to 10° below, at a maximum rate of 25° per sec. As the pilot is at the end of a swinging arm and approximately six feet away from the pitch axis, he can be swung through a large arc. Because the rates of roll and pitch are high, special dampers act as safety devices to limit the system's movement and override the pilot's commands should he make an error causing the cockpit to go beyond maximum tilt. The safety mechanisms also come into operation if there is a runaway in the control circuits. They slow the system down when it nears maximum tilt.

A cockpit will be supplied by the R.A.E. and fitted to the simulator after delivery. While under test by the makers a temporary pilot's seat and controls have been fitted. Extra weights have been added to represent the weight of the cockpit; that estimated for pilot and cockpit is more than 700 lb.

Conference on Icing

Sponsored by D. Napier and Son, Ltd., this year's Aircraft Ice Protection Conference is to be held on May 24. Mr. J. R. Ewans, B.Sc., D.I.C., A.C.G.I., F.R.Ae.S., chief designer of A. V. Roe and Co., Ltd., will be in the chair. To date delegations from Russia, the United States, France, Germany, Holland and Canada have accepted invitations to attend. Last year there were nearly 200 delegates from seven countries.

Papers to be read are "Boundary Layer Control and Anti-icing," by A. G. Smith and C. Jones of Blackburn Aircraft, Ltd., "Electrical De-icing of Helicopter Blades," by R. D. Crick of D. Napier and Son, Ltd., "Fluid De-icing," by D. C. Tanner of T.K.S. (Aircraft De-icing), Ltd., and "Ice Detectors," by Dr. D. P. Howlett of the de Havilland Aircraft Co., Ltd. Further information relating to the conference can be obtained from the secretary, Mr. B. B. Gallagher, D. Napier and Son, Ltd., Luton Airport, Beds.

Turbine Lubricant Approved

The Castrol Group announces that its synthetic aviation gas turbine lubricant, Castrol 98, has now received M.o.A. approval against specification D. Eng. R.D. 2487 (NATO code No. O-149, British Joint Services Nomenclature OX-38). According to the company this is the first British oil, and one of only two in the World, to hold this approval. The latest airlines to adopt it are Aer Lingus for its Viscounts and Friendships, M.E.A. for its Comets and Viscounts and Tradair for its Viscounts.

Service

L. A. Rumbold and Co., Ltd., aircraft seating specialists, tell us that they have recently delivered 61 seats to Philippine Air Lines only 27 days after receiving the order. These were a mixture of doubles weighing 37 lb. each, and triples of 52 lb. each. A letter of appreciation received by the Rumbold company from the airline describes this as "an outstanding achievement."

The Short moving-cockpit flight simulator under test with temporary pilot's seat and control lever. A cockpit will be fitted when the unit is delivered to the R.A.E.

Aviation Calendar

May 12

London.—B.I.S. One-day Symposium on "Communication Satellites," at the Federation of British Industries, 21 Tothill Street, S.W.1, from 10.00 to 17.00 hrs.

May 13

Lasham. — National Gliding Championships at Lasham Aerodrome, near Alton, Hants; until May 22.

May 15

Naples. — AGARD Ionospheric Research Committee Meeting on "Disturbances of Solar Origin on Communications"; until May 20.

May 18

London.—R.Ae.S. Astronautics and Guided Flight Section lecture, "The Agena Satellite and the Discoverer Programme," by R. Smelt, in the Lecture Theatre, 4 Hamilton Place, W.1, at 18.00 hrs.

May 20

Fréjus.—Fréjus St. Raphaël Aero Club Rally; until May 22.

May 22

Hucknall.—Air Display organized by R.A.F.A.

North Weald.—Air Display organized by R.A.F.A.

Yeadon.—International Air Pageant organized by S.S.A.F.A.

Company Notices

NEW COMPANY

R. B. Pullin and Co., Ltd. (688,428).—Private co. Reg. Mar. 30. Cap. £100,000 in £1 shs. To acquire the goodwill and freehold property and other assets of the business of instrument makers carried on by R. B. Pullin and Co., Ltd., at Phoenix Works, Great West Road, Brentford and elsewhere, but excepting its holdings of shares in Subsidiary Companies. Sols.: Godden Holme and Co., 5 Upper Belgrave Street, S.W.1.

CHANGE OF NAME

Helicopter Advisory Services, Ltd. (560,997), Westland Works, Yeovil.—Name changed to British Helicopters, Ltd., on Aug. 18, 1960.

New Patents

APPLICATIONS ACCEPTED

869,655.—**Aero Controls, Ltd.**—"Structure of aerofoil shape for use in aircraft." Aug. 12, 1957. (Aug. 23, 1956.) (Addition to 756,673.)

869,632.—**Boulton Paul Aircraft, Ltd.**—"Aircraft." Jne. 9, 1959. (Mar. 11, 1958.)

869,864.—**United Aircraft Corporation.**—"Method and apparatus for determining characteristics and mounting of rotor blades on rotary wing aircraft." Jly. 2, 1958. (Jly. 25, 1957 and Sept. 3, 1957.)

Printed specifications of the above will be available on Jne. 7, 1961, and the opposition period will expire on Sept. 7, 1961.

Personal Notices

BIRTHS

Barter.—On Apr. 18, at R.A.F. Hospital, Ely, to Valerie (*née* Crane), wife of Flt. Lt. J. Barter—a son.

Darlington.—On Apr. 18, at Banbury, to Jean Blanche (*née* Goding), wife of Flt. Lt. F. W. H. Darlington—a son.

Eggleton.—On Apr. 15, at R.A.F. Hospital, Wegberg, to Rosemary (*née* Barker), wife of Flt. Lt. D. Eggleton—a daughter.

Hunt.—On Apr. 16, at R.A.F. Hospital, Cosford, to Daphne (*née* Rust), wife of Peter A. Hunt—a daughter.

MacGregor.—On Mar. 10, at Eastergate, to Marjorie (*née* Griffiths), wife of Sqn. Ldr. J. R. MacGregor, R.A.F. (retd.)—a daughter.

Thomas.—On Apr. 13, at R.A.F. Hospital, Akrotiri, to Sylvia, wife of Flt. Lt. G. O. Thomas—a son.

MARRIAGE

Mekie-Field.—On Apr. 22 Edwin Eoin Cameron Mekie to Jane Margaret Field.

DEATHS

Hammond.—On Apr. 17, Sqn. Ldr. Frederick Gilders Hammond, R.A.F. (retd.).

Innes-Crump.—On Apr. 19, Air Cdre. John Edwin Innes-Crump.

Wrigley.—On Apr. 19, Flt. Lt. Noel Vincent Wrigley, R.A.F. (retd.).

Youell.—On Apr. 19, Capt. Alan Hamilton Youell.

THE AEROPLANE and ASTRONAUTICS CLASSIFIED ADVERTISEMENTS

PRESS DAY: Classified Advertisements must normally be received at Head Office by FIRST POST THURSDAY for the following Thursday's issue. Last-minute additions and deletions are accepted by telephone from trade advertisers up to noon. Advertisements received too late for a particular issue are automatically inserted in the succeeding one unless instructions to the contrary are received.

RATES—1/- per word (minimum 12 words 12/-). Each paragraph charged separately and name and address must be paid for. Semi-displayed setting £3-17-6 per single column inch. Centred lines 22/6. Series discounts of 5% for 13, 10% for 26 and 15% for 52 consecutive insertions, allowed to trade advertisers.

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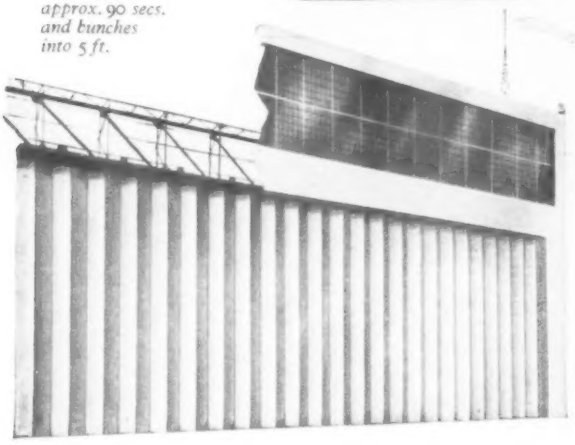

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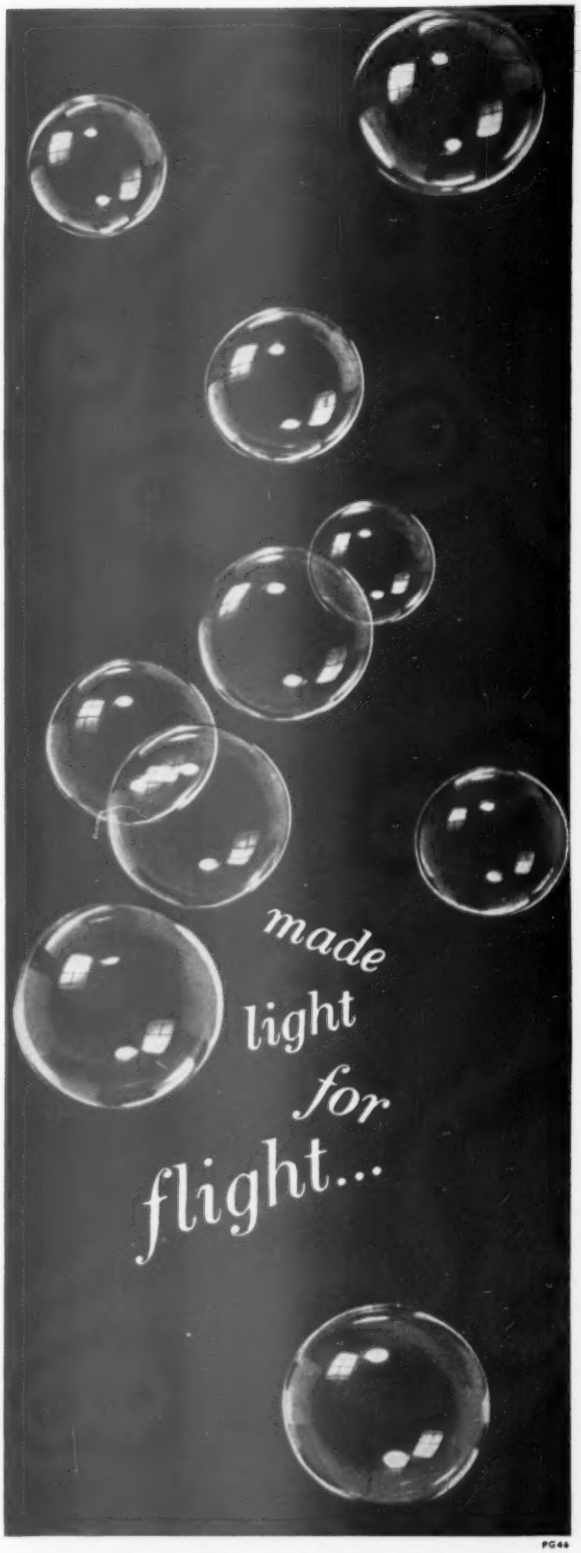

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